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U.S. Patent Application S.N. 10/695,177

Title: PROCESS FOR MANUFACTURING COMPOSITE PROFILES

Filing Date: October 28, 2003

First named inventor: Richard Anderson

Group Art Unit: 1732

Examiner: Matthew J. Daniels

Amended Appeal Brief

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

This is an appeal from the final office action mailed January 24, 2007. The notice of appeal and one month extension were filed May 23, 2007.

Table of Contents

Real party in interest

The real party in interest is Hunter Douglas Inc.

Related appeals and interferences

None

Status of claims

Claims 1-13 are rejected and are the subject of this appeal.

Claims 14-22 are cancelled.

Status of amendments

The response after final has been entered by the Examiner.

Summary of claimed subject matter

The design and method described in the present specification:

The present specification describes a process for forming a profile from two or more different materials to make a composite profile with an outside appearance of a single piece, which takes advantage of the desirable characteristics of the individual materials in the composite profile. One of the challenges in the prior art has been trying to find an economical way to closely align the materials forming the composite profile. Cutting the materials with close tolerances is very expensive. What is needed is a way to achieve precision alignment without requiring precision cutting. That problem has been solved by using a crush rib as a collapsible spacer and then pressing the pieces together, collapsing the crush rib just enough to bring the parts into proper alignment during assembly. An example of crush ribs 28 is shown in Figure 8. Figure 7 shows an insert 24 that has crushed the crush ribs while it was being inserted in order to bring the top surface of the insert into alignment with the top surface of the core.

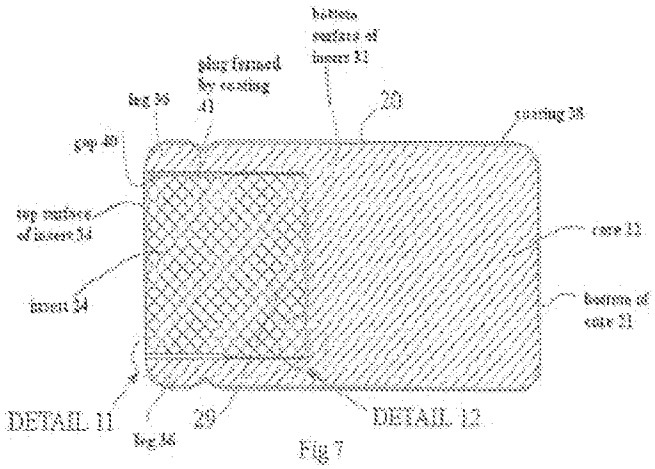


Fig 7

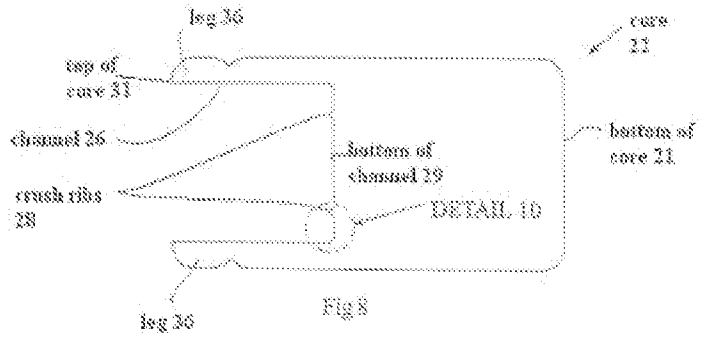


Fig 8

Once the composite profile has been formed with the parts in precise alignment, it can be passed through an extrusion die to apply a coating.

Other features described in the specification include the manner of using the coating to form a plug that creates a physical barrier to ensure that the insert remains in place. Figure 7 (above) shows the plug 41 formed by providing a recessed shoulder on the insert in order to create a wider gap 40 and then allowing the coating to fill that gap to create the plug 41. The insert 24 with shoulders 30 is shown separately in Figure 9 (below).

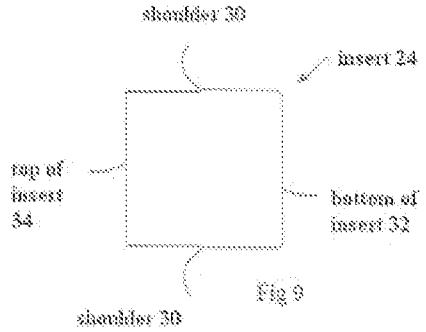


Fig 9

The insert may be glued in place. The specification describes pockets 242, shown in Figure 15 (below), for receiving excess glue. It also describes the problem of warping that can occur when the material absorbs the glue, and the method of solving the warping problem by providing a second insert 246 on the opposite side, as shown in Figure 15.

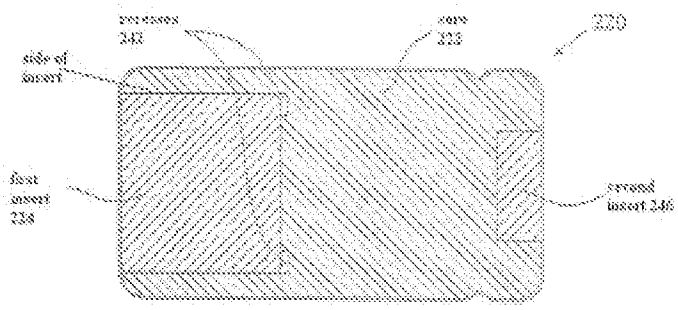


Fig 15

The claims:

Claim 1 recites a process for making a composite profile, including at least one core piece (22 of Fig. 7 – referred to on page 8, line 2 and lines 19-23) and one insert piece (24 of Fig. 7 – referred to on page 8, line 3 and page 9 lines 4-18), each having a top surface (34 is the top surface of the insert in Fig. 7; 31 is top of core piece in Fig. 8) and a bottom surface (32 is the bottom surface of the insert in Fig. 7), and a length extending from a first end to a second end, and each having substantially the same profile from its first end to its second end, wherein the core piece defines a first channel (26 in Fig. 8) sized to receive the

insert, the channel extending lengthwise from the first end to the second end. The steps include providing a crush rib (28 of Fig. 8 – referenced on page 8, line 23 to page 9, line 3) between the bottom surface of the insert piece and the channel, and pressing the insert piece into the first channel to deform the crush rib until the top surfaces of the insert and the core are aligned. (The process is described on page 9, line 15 to page 10 line 10.)

Claim 2 is the same as claim 1, except that it does not require the core and insert to have substantially the same profile from the first end to the second end, and it includes the additional step of passing the core and insert assembly through an extrusion die to apply a coating (38 in Fig. 11 below).

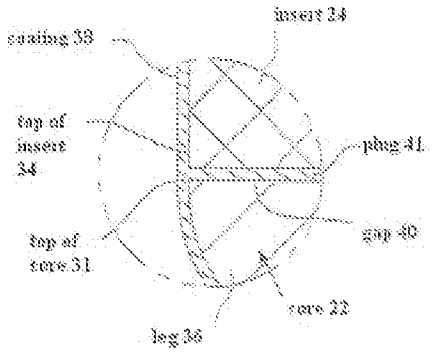


Fig. 11

Claim 3 depends from claim 2 and adds that the coating is a thermoplastic.

Claim 4 depends from claim 2 and adds the step of providing a wider gap between the insert and the core near the top than further into the core and applying coating into that wider gap. The gap 40 is shown in Figure 7 above, which also shows the coating forming a plug 41 in the wider portion of the gap.

Claim 5 depends from claim 4 and adds that the wider gap is formed by providing a recessed shoulder on the insert. A shoulder 30 is shown in Figure 9 above.

Claim 6 depends from claim 4 and adds that the wider gap is formed by making the channel wider at the top than at the bottom. This is shown in Figure 13 below, with the gap 140 being wider at the top due to the channel 126 being wider at the top.

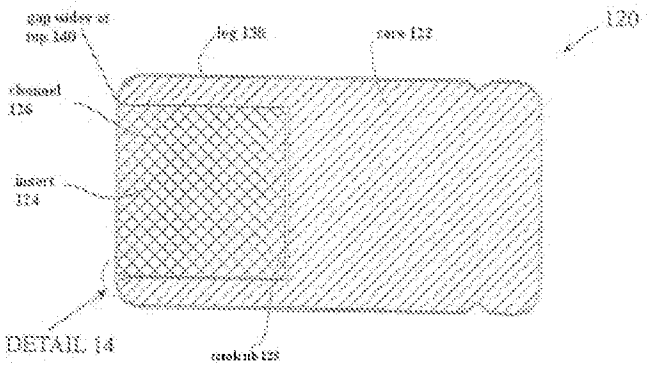


Fig 13

Claim 7 depends from claim 2 and adds that the insert defines one side surface, and the side surface defines a recessed shoulder, forming a gap between the core and the insert above the recessed shoulder, wherein the gap is filled with coating. Figure 9 above shows the recessed shoulders 30 on the side surfaces, and Figure 7 above shows the wider gap 40 above the recessed shoulders 30, which is filled with coating to form a plug 41.

Claim 8 depends from claim 2 and adds the limitation that the channel of the core piece defines at least one leg extending from the bottom surface to the top surface of the core piece, and the leg widens adjacent the top surface of the core to define a gap between the leg of the core and the insert and wherein the gap is filled with the coating. Figure 13 above shows an example of a leg 138 which widens adjacent the top surface to define a gap 140 that is filled with coating.

Claim 9 depends from claim 1 and includes the additional step of applying adhesive to the leg of the core or to the side surface of the insert prior to pressing the insert and core together. Page 12, lines 12-19 describes applying glue to the inside of the legs 236 of the core 222 of Figure 16 prior to inserting the insert 224, of Figure 15.

Claim 10 recites a process for making a composite profile, including at least one core piece (222 of Fig. 16) and one insert piece (224 of Fig. 15), each having a top surface and a bottom surface, and a first end and an opposite second end, wherein the core piece defines a first channel (226 of Fig. 16) sized to receive the insert piece (224), comprising the steps of providing a crush rib (28 of Fig. 8) between the bottom surface of the insert piece and the channel, pressing the insert piece into the first channel to deform the crush rib until the top surfaces of the insert and the core are aligned, wherein the channel defines at least one leg (236 of Fig. 16), and the insert defines at least one side surface, and applying adhesive to at least one of the leg and the side surface prior to

pressing the insert piece and core piece together, wherein the bottom surface of the core piece defines at least one shallow pocket (242 of Figs. 15 and 16) to act as a repository for any extra adhesive applied. (See the same portions of the specification referred to in claim 1, and page 12, lines 12-19.)

Claim 11 recites a process for making a composite profile, including at least one core piece and one insert piece, each having a top surface and a bottom surface, and a first and an opposite second end, wherein the core piece defines a first channel sized to receive the insert piece, comprising the steps of providing a crush rib between the bottom surface of the insert piece and the channel, pressing the insert piece into the first channel to deform the crush rib until the top surfaces of the insert and the core are aligned, wherein the channel defines at least one leg, and the insert piece defines at least one side surface, and applying adhesive to the leg or the side surface prior to pressing the insert and core piece together, and applying adhesive along an opposite second end of the core piece so as to counter uneven expansion due to moisture absorption by the core piece from the adhesive.

Most of the elements of this claim have been explained above. The application of the glue to the opposite second end (at the second channel 244 of Fig. 16) is described beginning on page 12, line 22 of the specification.

Claim 12 depends from claim 11 and adds the steps of providing a second channel along the opposite second end of the core and inserting a second insert piece into the second channel. The second insert 246 and second channel 244 are shown in Figures 15 and 16.

Claim 13 depends from claim 12 and adds that the second bottom surface defines at least one shallow pocket (similar to the shallow pockets 242 in the first bottom surface 228 of Figure 16).

Grounds of rejection to be reviewed on appeal

Claim 1 was rejected under 35 U.S.C. 103(a) as unpatentable over Curtis (USPN 4,615,163) in view of Pettersson (USPN 4,095,913), stating that Curtis teaches the core and insert and the other elements except for the crush rib, although Figure 5 of Curtis might be considered to have crush ribs, and Pettersson teaches a crush rib, and it would be obvious to put the crush ribs of Pettersson into Curtis to make the claimed invention for three reasons:

1. In order to allow expansion and contraction of the composite board of Curtis.
2. Because Curtis suggests physical modifications of the groove to facilitate adhesion by keying the two pieces together or increasing surface area as taught by Pettersson.
3. Because Curtis suggests a particular glue thickness, which Pettersson's ribs would provide.

Claim 2 was rejected as an obvious combination of Curtis, Pettersson, and Zanini (USPN 2,926,729). This uses the same basis for rejection as claim 1, and adds that Zanini teaches passing a composite comprised of interlocking strips through an extrusion die to apply a coating, which would be obvious to apply in order to mask the interface and provide the desirable aesthetic aspect of a singular and unitary piece.

Claim 3 was rejected on the same basis as claim 2, in addition stating that Zanini used a thermoplastic coating material.

Claims 4 and 5 were rejected on the same basis as claim 2, in addition stating that Curtis teaches that the shape of the insert may be selectively varied and teaches a configuration in Figure 2 that reads on these claims. The rejection also states that Zanini teaches that it is desirable for the coating material to provide wedging within the slots for bonding the strips together.

Claim 6 was rejected for the same reason as claim 2, stating that Curtis teaches to vary the shape of the insert and groove to complement the insert and to modify the groove to facilitate adhesion between the rod and groove surface by providing notches or other elements that can effect greater adhesion between the beam and rod by keying the cured resin to the wood core and reducing the likelihood of shifting when the beam is placed under load.

Claim 6 was further rejected in view of Parasin (USPN 5,165,816) and Olofsson (WO99/40273), stating that Parasin and Olofsson teach the claimed insert configurations, namely a channel wider at the top than at the bottom, and that it would have been obvious to incorporate the methods of Olofsson and

Parasin into Curtis to provide recesses for adhesive and spaces to accommodate expansion and contraction.

Claim 7 was rejected for the same reason as claim 2, and further in view of Olofsson and Del Rincon (USPN 65,694,730), stating that Olofsson and Del Rincon teach the claimed insert configurations, namely the recessed shoulder, and that it would be obvious to make that combination to provide a recess for adhesive and to maximize the board retention of the insert.

Claim 8 was rejected for the same reason as claim 6, and, if necessary, adding Olofsson and Parasin, for teaching a leg that widens adjacent the top surface of the core piece to define a gap, for providing recesses for adhesive and spaces to accommodate expansion and contraction, both aspects being desirable in beams.

Claim 9 was rejected for the same reason as claim 1, stating that Curtis teaches an adhesive being applied to one or both of the leg and insert.

Claim 10 was rejected based on a combination of Curtis and Pettersson, stating that Curtis has repositories for glue in Figures 5-8 and is silent on crush ribs, but that Pettersson teaches the use of crush ribs, and that it would have been obvious to incorporate the method of Pettersson into that of Curtis in order to allow expansion and contraction of the composite board. Additionally, it was stated that the combination can be interpreted to define the repository in that some glue would be present between the crush ribs of Pettersson.

Claim 11 was rejected based on a combination of Curtis, Pettersson, and Kalinin (USPN 5,497,595), stating that Curtis teaches the basic elements but not the crush ribs or the step of applying adhesive along an opposite second surface to counter uneven expansion. However, the rejection states that area 14 of Figure 5 of Curtis could be considered to be a crush rib, which would deform some amount when inserting the insert, and that the countering of uneven expansion is an intended use or effect, and that this limitation is met by oppositely located cores, which would inherently or implicitly provide this effect. In the alternative, it was stated that Pettersson teaches the crush ribs, and Kalinin teaches providing inserts on both the top and bottom surfaces of a beam. It was stated that it would be obvious to make the combination for four reasons:

1. In order to allow expansion and contraction of the composite board
2. Because Curtis suggests physical modifications of the groove to facilitate adhesion by keying two pieces together or increasing surface area, which Pettersson provides
3. Because Curtis suggests a particular glue thickness which Pettersson's ribs would provide
4. To improve the stiffness and strength of the beam (Kalinin)

Claim 12 was rejected for the same reasons as claim 11, and, in addition, stating that a second channel, a second surface, and a second insert are conventional in the art, as taught by Kalinin.

Claim 13 was rejected for the same reasons as claim 11, and in addition stating that Curtis teaches that the core piece defines at least one shallow pocket to act as a repository for any extra adhesive applied. Particularly in Figs. 5-8 the insert is interpreted as defining the repository in substantially the same way shown in the application.

Argument

The rejections were based on seven prior art references, which are summarized below.

1. U.S. Patent 4,615,163 "Curtis et al."

This reference teaches reinforcing a wooden beam by gluing a fiberglass/resin rod into a groove in the beam. In some embodiments, such as the embodiment of Figures 1 and 2, the beam 10 and rod 12 have the same cross-section along their entire length; in others they do not. Glue 22 fills in the space between the beam and the rod and provides a smooth top surface.

FIG. 1

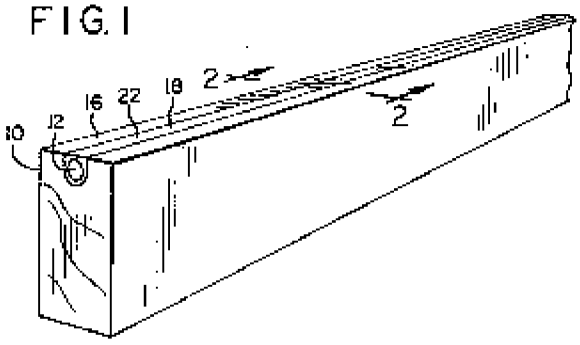


FIG. 2

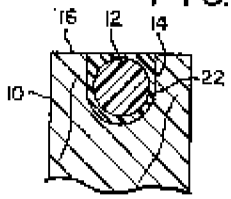
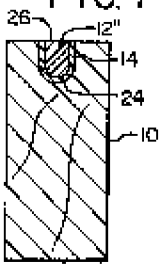


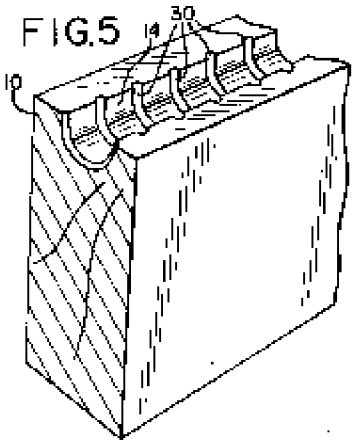
FIG. 4



In the embodiment of Figure 4, the rod 12" is flush with the top of the beam. This is achieved by controlling the amount of glue between the rod 12" and the beam.

In the embodiment of Figure 5, there are notches 30 in the beam for receiving glue to key the rod and beam together, so, in this embodiment, the beam does not have the same cross-section along its entire length.

FIG. 5



2. U.S. Patent 4,095,913 "Pettersson et al."

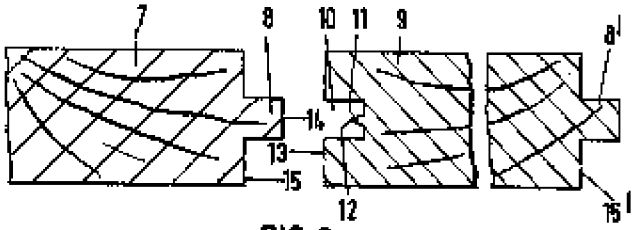


FIG. 3.

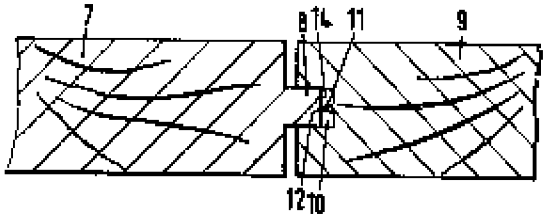
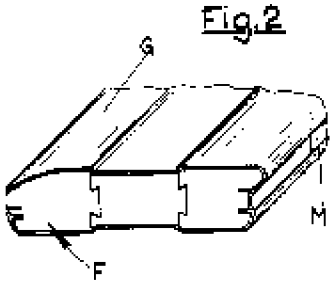


FIG. 4.

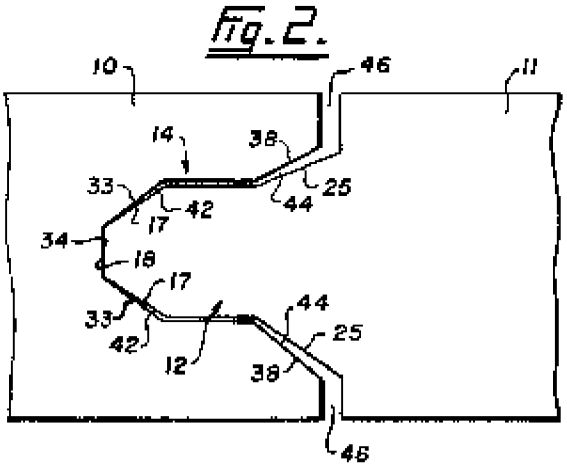
This patent teaches a method for preventing buckling of boards that are connected together with tongue and groove joints. It provides a protuberance 11 at the bottom of the groove, which abuts the tongue of the next board during assembly, thereby keeping the boards spaced apart by a gap during installation, and preventing the faces 13, 15 of the boards from contacting each other. Then, after installation, if the boards swell, the end of the protuberance 11 can collapse and give the boards room to expand, thereby preventing buckling of the boards. **It should be noted that the purpose of the protuberance 11 is to prevent the boards from coming into alignment with each other, both during assembly and thereafter.**

3. U.S. Patent 2,926,729 "Zanini"

This reference teaches a process for coating wooden laths. The coating is applied by extrusion, and the coating enters into the grooves, helping to bond the strips together.



4. U.S. Patent 5,165,816 "Parasin"



This reference teaches a tongue and groove arrangement in which the tongue is tapered for easy insertion into the groove.

5. U.S. Patent 5,497,595 "Kalinin"

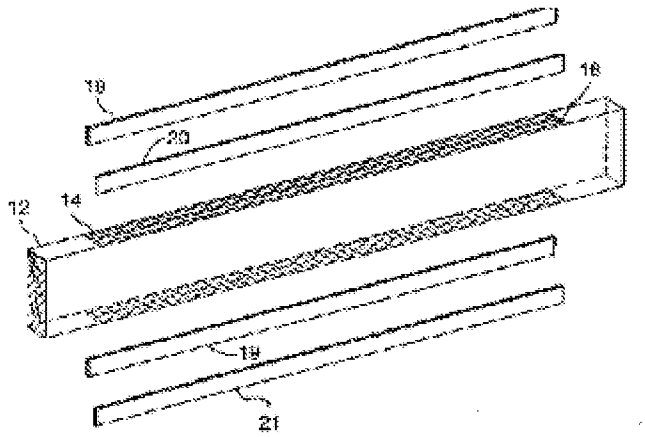
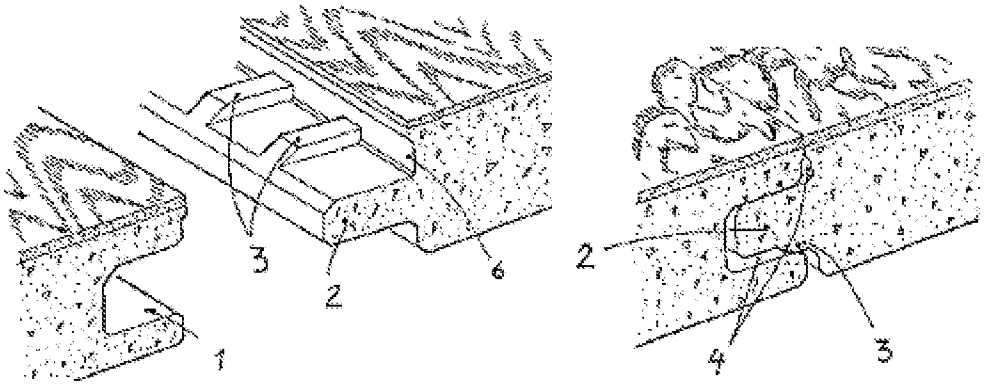


FIG.1.

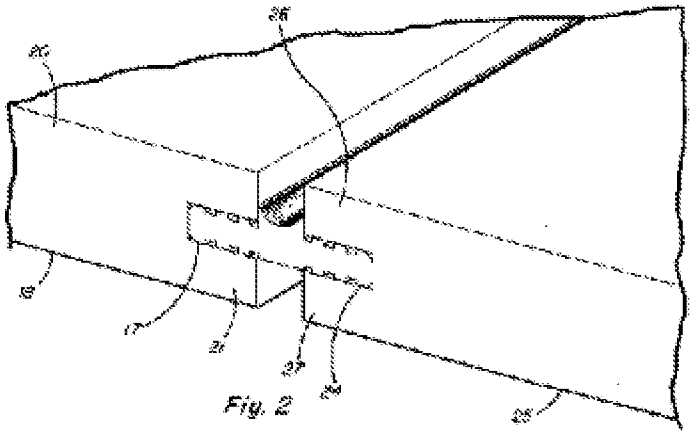
This patent teaches the use of steel strips bonded within longitudinal kerfs in a beam to reinforce the beam.

6. WO 99/40273 "Olofsson"



This patent teaches a tongue and groove joint in which the tongue 2 includes guiding wedges 3. It also includes recesses 6 that form cavities 4 for receiving glue.

7. U.S. Patent 5,694,730 "Del Rincon et al."



This patent teaches a splined joint.

Claim 1:

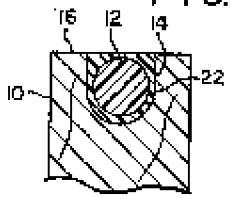
Claim 1 recites the following:

1. A process for making a composite profile, including at least one core piece and one insert piece, each having a top surface and a bottom surface, and a length extending from a first end to a second end, and each having substantially the same profile from its first end to its second end, wherein said core piece defines a first channel sized to receive said insert piece, said channel extending lengthwise from said first end to said second end, comprising the steps of:

providing a crush rib between the bottom surface of the insert piece and the channel; and

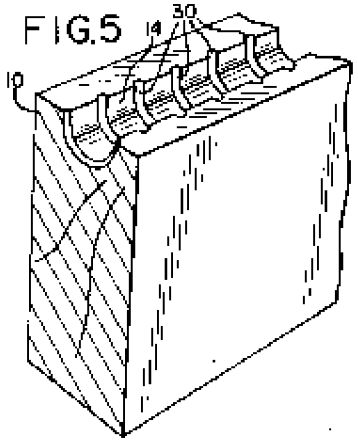
pressing said insert piece into said first channel to deform the crush rib until the top surfaces of the insert and the core are aligned.

FIG. 2



This claim was rejected based on a combination of Curtis and Pettersson. One part of the rejection says that Curtis does not teach the use of a crush rib, while another part of the rejection says that Figure 5 of Curtis shows a crush rib 14. A reading of Curtis makes it clear that it does not teach the use of a crush rib. To the extent that the portions 14 of Figure 5 are ribs, they are not crushed during assembly or at any other time. As shown in Figure 2, there is a cushion of glue 22 between the rod 12 and the portion 14 of the beam, which prevents any crushing of the portion 14. Thus, the portion 14 of the beam cannot be considered to be a crush rib.

FIG. 5

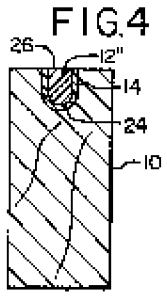


The rejection says that Curtis teaches a core piece and insert, each having the same profile from end to end, wherein the core piece defines a channel sized to receive the insert piece, the channel extending to both ends, inserting the insert piece into the channel with the top of the insert initially above the top surface of the core, and pressing the insert into the channel such that the

surfaces of the insert and core are aligned. It then states that it would be obvious to incorporate the method of Pettersson into Curtis to make the claimed invention for three reasons:

1. To allow expansion and contraction of the composite board;
2. Because Curtis suggests physical modifications of the groove to facilitate adhesion by keying the two pieces together or increasing surface area;
3. Because Curtis suggests a particular glue thickness, which Pettersson's ribs would provide.

This rejection is improper for several reasons. First, combining the teaching of Pettersson with the teaching of Curtis would not make the claimed invention.



Curtis teaches an insert that is glued into a recess in the beam, and the position of the insert is determined by the thickness of the glue. Figure 4, in particular, shows that the way to align the top surface of the insert 12" and the top surface of the beam 10 is to provide sufficient glue between the insert and the beam to put the insert in the desired position relative to the beam. The specification of Curtis does not say whether the rod is inserted downwardly from the top or lengthwise from the end, how the glue is inserted, or how the rod is held in the proper position while the glue dries.

Pettersson teaches a way to assemble a tongue and groove joint by pressing the tongue into the groove until the tongue abuts a protuberance 11, thereby preventing the faces of the adjoining boards from coming into alignment with each other.

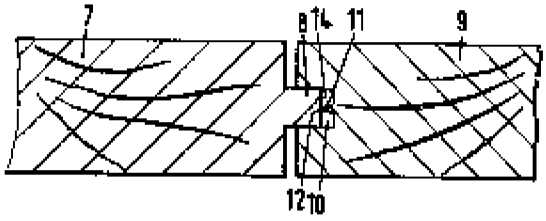


FIG.4.

If the teachings of Curtis and Pettersson were combined, they would not teach a method of assembly by which the rod of Curtis is pressed against a crush rib, crushing the rib to bring the top surface of the insert into alignment with the top surface of the beam, as claimed. To the contrary, Pettersson teaches the use of a rib 11 to **prevent alignment during assembly, not to achieve alignment.** Thus, if the teaching of Pettersson were combined with Curtis, it would provide a protuberance at the bottom of the channel to hold the rod up and prevent the rod from aligning with the top of the beam during assembly, not for bringing the rod into alignment with the top of the

beam as recited in claim 1. Since Pettersson specifically teaches using a crush rib to prevent alignment during assembly, crushing the rib to achieve alignment as stated in the rejection would be acting against the teaching of Pettersson. **It cannot be considered obvious to a person skilled in the art to act against the teaching of a reference.**

Another reason the rejection is improper is that the method of Pettersson is completely incompatible with the method of Curtis, and therefore the two methods could not be combined. The method of Pettersson uses the protuberance 11 to hold the boards apart during assembly and requires the two boards to be free to move relative to each other after assembly to crush the rib to prevent buckling. Only if the boards are free to move relative to each other after assembly does the rib ever get crushed. On the other hand, in Curtis, the insert is glued into the channel in the beam and is fixed in position so it cannot move after assembly. Since Curtis does not allow the beam and insert to move relative to each other after assembly as required by Pettersson, it cannot take advantage of the method taught by Pettersson.

The motivations for making the combination of Curtis and Pettersson that are stated in the rejection also do not make the combination obvious to a person of ordinary skill in the art, as explained below.

The first reason for the combination that is given in the Office Action is that it would be obvious to put the rib of Pettersson into the channel of Curtis to allow for expansion and contraction of the composite board. However, Curtis teaches that the parts are solidly glued together, so there can be no relative movement of the beam and insert after assembly. Even if a rib were put between the bottom of the insert and the channel of Curtis, it would be completely surrounded by glue and therefore unable to deform or to be crushed if the composite board later expanded or contracted. Finally, the top surfaces would already be aligned and the parts glued together before any deformation could take place, so even if there were some deformation of a rib due to expansion or contraction after the insert is glued in, that deformation would not meet the limitations of claim 1, which requires pressing the insert into the channel to deform the crush rib until the top surfaces of the insert and core are aligned. Since the top surfaces would already be in alignment, any crushing of a rib due to expansion and contraction would not involve pressing the insert into the channel to deform the crush rib until the top surfaces of the insert and core are aligned as required by claim 1. Thus, the first reason for the combination that is given in the Office Action, namely to put a rib into the channel of Curtis to allow for expansion and contraction of the composite board, does not provide an obvious combination that would meet the limitations of claim 1.

The second reason for the combination that was given in the Office Action was that it would be obvious to put a rib between the insert and groove or

channel of Curtis because Curtis suggests physical modifications of the groove to facilitate adhesion by keying the two pieces together or increasing surface area. However, if a rib were put in that position for that purpose, it would not achieve what is recited in claim 1, namely crushing the rib to bring the top surfaces into alignment. Instead, if a rib were inserted to facilitate adhesion or keying or increasing surface area, then the goal would be to keep the rib intact in order to provide the greater surface area for adhesion. If the insert contacted the rib and crushed it, that would mean that there would not be a place between the insert and rib in that area to receive glue, which would result in smaller surface area and less adhesion. In any case, there still would be no suggestion to crush the rib to bring the top surfaces into alignment as recited in claim 1. Thus, the second reason for the combination that was given in the Office Action also does not provide an obvious combination that would result in the claimed invention.

The third reason for combining Pettersson and Curtis that was given in the Office Action was because Curtis suggests a particular glue thickness, which Pettersson's ribs would provide. Again, if some type of ribs were provided to hold the insert a fixed distance above the bottom of the groove or trough to maintain a desired glue thickness, then crushing the ribs would defeat that purpose. Also, the ribs themselves would cause the glue thickness to be thinner or nonexistent in the area of the ribs, thereby defeating the goal of having a uniform glue thickness. Thus, the claimed combination cannot be considered obvious both because it goes against the teaching of a uniform glue thickness, and because the proposed combination would not create the claimed invention, which requires pressing the insert into the channel to deform the rib until the top surfaces of the insert and core are aligned.

The Examiner has taken the position that some amount of deformation is inherent, so, essentially, if there is anything between the bottom of the trough and the insert, it becomes a crush rib due to inherent deformation, and, if there is anything that can be called a crush rib between the insert and the bottom of the trough, the claim limitations are met. Applicant respectfully disagrees.

First, it is improper to assume that deformation is inherent. Even if a rib is provided between the bottom of the trough and the insert, that does not mean it will deform or be crushed. For example, in Figure 5 of Curtis, there would not be any deformation, because the glue would provide a cushion that would prevent deformation. If the rib is inserted to provide a spacer, then deformation of the rib would defeat its intended purpose, so such deformation cannot be assumed. Furthermore, even if it were considered to be obvious to insert a rib for some purpose, and even if it were accepted that some deformation of the rib would be inherent, there is no teaching or suggestion in the prior art to provide deformation of the rib in the manner and to the extent that is recited in claim 1, namely, for the insert to crush the rib until the top surfaces of the insert and core are aligned.

The only reference that teaches crushing a rib until the top surfaces are brought into alignment is the present application. Neither Curtis nor Pettersson nor any logical combination of those references teaches or suggests that claim element. Since any combination of Pettersson and Curtis as suggested by the Examiner would not result in the invention recited in claim 1, that claim should be allowed.

Claim 2:

Claim 2 is the same as claim 1, except that it does not require the core and insert to have substantially the same profile from the first end to the second end, and it includes the additional step of passing the core and insert assembly through an extrusion die to apply a coating (38 in Fig. 11).

Claim 2 was rejected as an obvious combination of Curtis, Pettersson, and Zanini (USPN 2,926,729). This uses the same basis for rejection as claim 1, and adds that Zanini teaches passing a composite comprised of interlocking strips through an extrusion die to apply a coating, which would be obvious to apply in order to mask the interface and provide the desirable aesthetic aspect of a singular and unitary piece. Applicant agrees that Zanini teaches coating by passing through an extrusion die. However, Zanini adds nothing to suggest pressing the insert toward the crush rib to crush the crush rib until the top surfaces of the insert and the core are aligned, as recited in claim 2. Thus, claim 2 recites an invention that is novel and unobvious in view of Curtis, Pettersson and Zanini for the same reasons expressed with respect to claim 1.

Claim 3:

Claim 3 depends from claim 2 and adds the limitation that the coating is a thermoplastic. This claim recites an invention that is novel and unobvious for the same reasons as claims 1 and 2.

Claim 4:

This claim depends from claim 2 and adds the step of providing a wider gap between the insert and the core near the top than further into the core and applying a coating into that wider gap.

Claim 4 was rejected on the same basis as claim 2, in addition stating that Curtis teaches that the shape of the insert may be selectively varied and teaches a configuration in Figure 2 that reads on these claims. The rejection also states

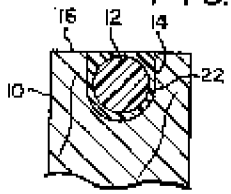
that Zanini teaches that it is desirable for the coating material to provide wedging within the slots for bonding the strips together.

The Curtis reference teaches that any gap between the insert and the core is filled with glue, so any product prepared in accordance with Curtis would not have a gap to be filled in with coating as recited in this claim. Therefore, in addition to the reasons explained with respect to claim 1, this claim recites an invention that is novel and unobvious because Curtis teaches filling in the entire space with glue, so there would be no gap that could be filled with the coating material of Zanini.

Claim 5:

This claim depends from claim 4 and adds the limitation that the wider gap is formed by providing a recessed shoulder on the insert. The Office Action states that Figure 2 of Curtis teaches such a configuration. However, that is not the case. As shown below, Figure 2 shows an insert having a circular cross-section, so the insert does not define a recessed shoulder as recited in claim 5. Thus, in addition to the reasons recited above with respect to claim 4, this claim recites an invention that is both novel and unobvious because the cited art does not teach the recessed shoulder as claimed.

FIG. 2



Claim 6:

This claim depends from claim 4 and recites that the wider gap is formed by making the channel wider at the top edge than at the bottom.

Claim 6 was rejected for the same reason as claim 2, in addition stating that Curtis teaches to vary the shape of the insert and groove to complement the insert and to modify the groove to facilitate adhesion between the rod and groove surface by providing notches or other elements that can effect greater adhesion between the beam and rod by keying the cured resin to the wood core and reducing the likelihood of shifting when the beam is placed under load.

However, the rejection does not point to anything in Curtis that teaches providing a wider gap by making the channel wider at the top edge than at the

bottom, because there is nothing in Curtis to provide such a teaching. Figure 3 of Curtis shows a channel that is wider at the top than at the bottom, but the insert also is wider at the top than at the bottom, so there is no wider gap. Furthermore, as explained above, Curtis teaches no gap that could be filled in with coating material as claimed, because any existing gap is filled in with glue before any coating step could be conducted.

Claim 6 was further rejected in view of Parasin (USPN 5,165,816) and Olofsson (WO99/40273), stating that Parasin and Olofsson teach the claimed insert configurations, namely a channel wider at the top than at the bottom, and that it would have been obvious to incorporate the methods of Olofsson and Parasin into Curtis to provide recesses for adhesive and spaces to accommodate expansion and contraction.

Parasin and Olofsson both teach tongue and groove joints, not a composite profile as recited here. It is not at all clear how a person of ordinary skill in the art would apply the teachings of Parasin and Olofsson to the reinforced piece of lumber taught in Curtis, which does not involve a tongue and groove joint. Furthermore, as explained above, Curtis teaches that the entire gap between the insert and the core is filled with glue, which leaves no gap of any shape to be filled in by any coating material that might be applied later on. Therefore, for this reason and for the reasons previously expressed with respect to claim 4, the invention recited in claim 6 is both novel and unobvious in view of the cited references.

Claim 7:

Claim 7 depends from claim 2 and recites that the insert defines at least one side surface and the side defines at least one recessed shoulder, forming a gap between the core and insert above the recessed shoulder, and wherein the gap is filled with coating.

Claim 7 was rejected for the same reason as claim 2, and further in view of Olofsson and Del Rincon (USPN 65,694,730), stating that Olofsson and Del Rincon teach the claimed insert configurations, namely the recessed shoulder, and that it would be obvious to make that combination to provide a recess for adhesive and to maximize the board retention of the insert.

If a recess were provided for adhesive as stated in the rejection, then the adhesive filling the recess during assembly of the parts as taught by Curtis would prevent its being filled with coating later on. Therefore, for this reason and for the reasons expressed with respect to claim 2, these references do not teach or suggest the claimed invention.

Claim 8:

Claim 8 depends from claim 2 and recites that the leg of the channel widens adjacent the top surface to define a gap between the leg of the core piece and the insert piece, wherein the gap is filled with coating.

Claim 8 was rejected for the same reason as claim 6, and, if necessary, adding Olofsson and Parasin, for teaching a leg that widens adjacent the top surface of the core piece to define a gap, for providing recesses for adhesive and spaces to accommodate expansion and contraction, both aspects being desirable in beams.

Again, as explained earlier, it is not clear how the teachings of a tongue and groove joint could be applied to Curtis, which is not a tongue and groove joint. Furthermore, as explained above, Curtis teaches filling the entire space between the insert and core with adhesive, which would leave no gap to be filled with coating as claimed. For this reason and for the reasons explained with respect to claim 2, this claim defines an invention that is novel and unobvious.

Claim 9:

Claim 9 depends from claim 1 and adds the step of applying adhesive to at least one of the leg of the channel and the side surface of the insert prior to pressing the insert and core together.

Claim 9 was rejected for the same reason as claim 1, stating that Curtis teaches an adhesive being applied to one or both of the leg and insert.

Applicant agrees that Curtis teaches applying adhesive. However, this claim recites an invention that is both novel and unobvious for the reasons expressed with respect to claim 1.

Claim 10:

Claim 10 recites:

A process for making a composite profile, including at least one core piece and one insert piece, each having a top surface and a bottom surface, and a first end and an opposite second end, wherein said core piece defines a first channel sized to receive said insert piece, comprising the steps of:

providing a crush rib between the bottom surface of the insert piece and the channel;

pressing the insert piece into said first channel to deform the crush rib until the top surfaces of the insert and the core are aligned;

wherein said channel defines at least one leg, and said insert piece defines at least one side surface, and

applying adhesive to at least one of said leg and said side surface prior to pressing said insert piece and said core piece together;

wherein said bottom surface of said core piece defines at least one shallow pocket to act as a repository for any extra adhesive applied.

Claim 10 was rejected based on a combination of Curtis and Pettersson, stating that Curtis has repositories for glue in Figures 5-8 and is silent on crush ribs, but that Pettersson teaches the use of crush ribs, and that it would have been obvious to incorporate the method of Pettersson into that of Curtis in order to allow expansion and contraction of the composite board. Additionally, it was stated that the combination can be interpreted to define the repository in that some glue would be present between the crush ribs of Pettersson.

Applicant agrees that some embodiments of Curtis teach recesses that would be filled with adhesive. However, as explained earlier with respect to claim 1, it would not be obvious to use the crush rib of Pettersson in the Curtis arrangement to accommodate expansion and contraction, because the parts would be permanently glued together and there could be no shifting of parts relative to each other to take advantage of the crush rib as taught by Pettersson. Furthermore, neither Curtis nor Pettersson nor any logical combination of those references teaches pressing the insert piece into the channel to deform the crush rib until the top surfaces of the insert and the core are aligned, as recited in this claim. Therefore, this claim recites an invention that is both novel and unobvious.

Claim 11:

Claim 11 recites:

A process for making a composite profile, including at least one core piece and one insert piece, each having a top surface and a bottom surface, and a first end and an opposite second end, wherein said core piece defines a first channel sized to receive said insert piece, comprising the steps of:

providing a crush rib between the bottom surface of the insert piece and the channel;

pressing the insert piece into said first channel to deform the crush rib until the top surfaces of the insert and the core are aligned;

wherein said channel defines at least one leg, and said insert piece defines at least one side surface, and

applying adhesive to at least one of said leg and said side surface prior to pressing said insert piece and said core piece together;

and further comprising the step of applying adhesive along an opposite second end of said core piece so as to counter uneven expansion due to moisture absorption by said core piece from said adhesive.

Claim 11 was rejected based on a combination of Curtis, Pettersson, and Kalinin (USPN 5,497,595), stating that Curtis teaches the basic elements but not the crush ribs or the step of applying adhesive along an opposite second surface to counter uneven expansion. However, the rejection states that area 14 of Figure 5 of Curtis could be considered to be a crush rib, which would deform some amount when inserting the insert, and that the countering of uneven expansion is an intended use or effect, and that this limitation is met by oppositely located cores, which would inherently or implicitly provide this effect. In the alternative, it was stated that Pettersson teaches the crush ribs, and Kalinin teaches providing inserts on both the top and bottom surfaces of a beam. It was stated that it would be obvious to make the combination for four reasons:

1. In order to allow expansion and contraction of the composite board
2. Because Curtis suggests physical modifications of the groove to facilitate adhesion by keying two pieces together or increasing surface area, which Pettersson provides
3. Because Curtis suggests a particular glue thickness which Pettersson's ribs would provide
4. To improve the stiffness and strength of the beam (Kalinin)

While Kalinin does teach reinforcing a beam on opposite sides, none of the cited references, Curtis, Pettersson, or Kalinin, individually or together, teach pressing an insert piece into a channel of a core to deform a crush rib until the top surfaces of the insert and core are aligned as recited in this claim. Therefore, this claim recites an invention that is both novel and unobvious.

Claim 12:

This claim depends from claim 11 and adds the steps of providing a second channel along the opposite second end of the core and inserting a second insert into the second channel.

Claim 12 was rejected for the same reasons as claim 11, and, in addition, stating that a second channel, a second surface, and a second insert are conventional in the art, as taught by Kalinin.

This claim recites an invention that is both novel and unobvious for the reasons expressed with respect to claim 11.

Claim 13:

This claim depends from claim 12 and adds that the second bottom surface defines at least one shallow pocket to act as a repository for extra adhesive applied.

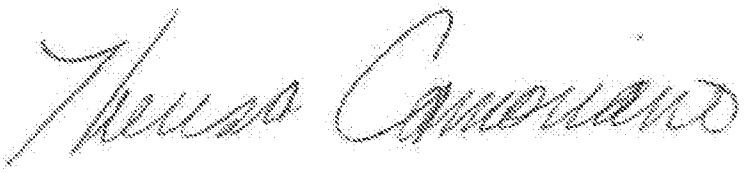
Claim 13 was rejected for the same reasons as claim 11, and in addition stating that Curtis teaches that the core piece defines at least one shallow pocket to act as a repository for any extra adhesive applied. Particularly in Figs. 5-8 the insert is interpreted as defining the repository in substantially the same way shown in the application.

This claim recites an invention that is both novel and unobvious for the reasons expressed with respect to claim 11.

Conclusion:

Since all the claims pending in this application recite an invention that is both novel and unobvious in view of the cited art, Applicant respectfully requests allowance of all the pending claims.

Respectfully submitted,



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Claims appendix

1. (previously presented) A process for making a composite profile, including at least one core piece and one insert piece, each having a top surface and a bottom surface, and a length extending from a first end to a second end, and each having substantially the same profile from its first end to its second end, wherein said core piece defines a first channel sized to receive said insert piece, said channel extending lengthwise from said first end to said second end, comprising the steps of:

providing a crush rib between the bottom surface of the insert piece and the channel; and

pressing said insert piece into said first channel to deform the crush rib until the top surfaces of the insert and the core are aligned.

2. (previously presented) A process for making a composite profile, including at least one core piece and one insert piece, each having a top surface and a bottom surface, and a first end and an opposite second end, wherein said core piece defines a first channel sized to receive said insert piece, comprising the steps of:

providing a crush rib between the bottom surface of the insert piece and the channel;

pressing said insert piece into said first channel to deform the crush rib until the top surfaces of the insert and the core are aligned, thereby forming a

core and insert assembly; and passing the core and insert assembly through an extrusion die to apply a coating.

3. (previously presented) A process for making a composite profile as recited in claim 2, wherein said coating is a thermoplastic.

4.(original) A process for making a composite profile as recited in claim 2, and further comprising the step of providing a wider gap between the insert and the core near the top than further into the core and applying coating into that wider gap.

5.(Original) A process for making a composite profile as recited in claim 4, wherein said wider gap is formed by providing a recessed shoulder on said insert.

6.(Original) A process for making a composite profile as recited in claim 4, wherein said wider gap is formed by making the channel wider at the top edge than at the bottom.

7.(original) A process for making a composite profile as recited in claim 2, wherein said insert piece further defines at least one side surface, and said side surface defines at least one recessed shoulder, forming a gap between said

core piece and said insert piece above said recessed shoulder, and wherein said gap is filled with said coating.

8.(original) A process for making a composite profile as recited in claim 2, wherein said channel of said core piece defines at least one leg extending from said bottom surface to said top surface of said core piece, and said leg widens adjacent said top surface of said core piece to define a gap between said leg of said core piece and said insert piece, and wherein said gap is filled with said coating.

9.(Original) A process for making a composite profile as recited in claim 1, wherein said channel defines at least one leg, and said insert piece defines at least one side surface, and further comprising the step of applying adhesive to at least one of said leg and said side surface prior to pressing said insert piece and said core piece together.

10. (previously presented) A process for making a composite profile, including at least one core piece and one insert piece, each having a top surface and a bottom surface, and a first end and an opposite second end, wherein said core piece defines a first channel sized to receive said insert piece, comprising the steps of:

providing a crush rib between the bottom surface of the insert piece and the channel;

pressing the insert piece into said first channel to deform the crush rib until the top surfaces of the insert and the core are aligned;

wherein said channel defines at least one leg, and said insert piece defines at least one side surface, and

applying adhesive to at least one of said leg and said side surface prior to pressing said insert piece and said core piece together;

wherein said bottom surface of said core piece defines at least one shallow pocket to act as a repository for any extra adhesive applied.

11. (previously presented) A process for making a composite profile, including at least one core piece and one insert piece, each having a top surface and a bottom surface, and a first end and an opposite second end, wherein said core piece defines a first channel sized to receive said insert piece, comprising the steps of:

providing a crush rib between the bottom surface of the insert piece and the channel;

pressing the insert piece into said first channel to deform the crush rib until the top surfaces of the insert and the core are aligned;

wherein said channel defines at least one leg, and said insert piece defines at least one side surface, and

applying adhesive to at least one of said leg and said side surface prior to pressing said insert piece and said core piece together;

and further comprising the step of applying adhesive along an opposite second end of said core piece so as to counter uneven expansion due to moisture absorption by said core piece from said adhesive.

12. (Original) A process for making a composite profile as recited in claim 11, and further comprising the steps of:

providing a second channel along said opposite second end of said core piece; and

inserting a second insert piece into said second channel.

13. (Original) A process for making a composite profile as recited in claim 12, wherein said second channel defines a second bottom surface, and said second bottom surface defines at least one shallow pocket to act as a repository for any extra adhesive applied.

Claims 14-22 (cancelled)

Appendix 2 - Evidence

Appendix 2A – U.S. Patent 4,615,163 "Curtis et al."

United States Patent [19]

Curtis et al.

[11] Patent Number: 4,615,163

[45] Date of Patent: Oct. 7, 1986

[54] REINFORCED LUMBER

[76] Inventors: Albert B. Curtis, 2375 Dellwood Ave., Lake Oswego, Oreg. 97034; J. Kenneth Brody, 2763 SW. Summit Dr., Portland, Oreg. 97201

[21] Appl. No.: 657,742

[22] Filed: Oct. 4, 1984

[51] Int. Cl.[4] E04C 3/30

[52] U.S. Cl. 52/730; 52/821; 52/309.13

[58] Field of Search 52/727, 730, 821, 829, 52/827, 828, 368, 376, 309.13, 309.14; 428/192

[56] References Cited

U.S. PATENT DOCUMENTS

1,084,276	1/1914	Jaminet	52/821 X
1,673,565	6/1928	Heath	52/821 X
2,851,747	9/1958	Rolen	52/376 X
3,077,012	2/1963	Speraw	52/309.13 X
3,251,162	5/1966	Strimple .	
3,294,608	12/1966	Peterson .	
3,533,203	10/1970	Fischer et al. .	
3,717,886	2/1973	Watts .	
3,890,077	6/1975	Holman .	
3,893,273	7/1975	Sailor .	
4,275,537	6/1981	Pinson .	
4,312,162	1/1982	Medney .	
4,443,990	4/1984	Johnson	52/730 X

Primary Examiner—Carl D. Friedman

Attorney, Agent, or Firm—Klarquist, Sparkman, Campbell, Leigh & Whinston

[57] ABSTRACT

A wooden beam is reinforced with a polyester rod glued within groove on surface to increase the ultimate strength of the beam under stress and reduce deviation of strength between beams.

13 Claims, 11 Drawing Figures

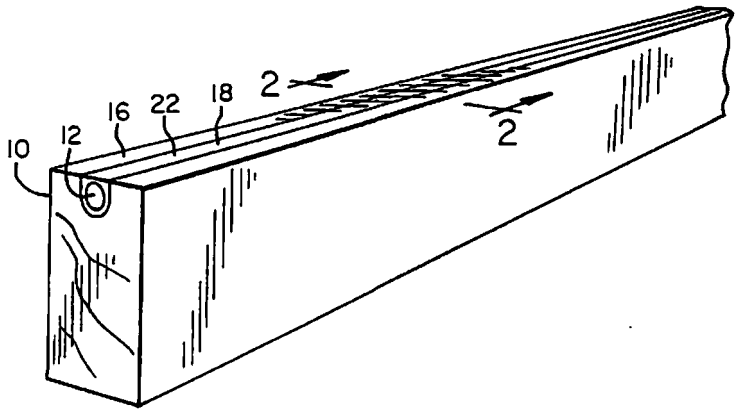


FIG. 1

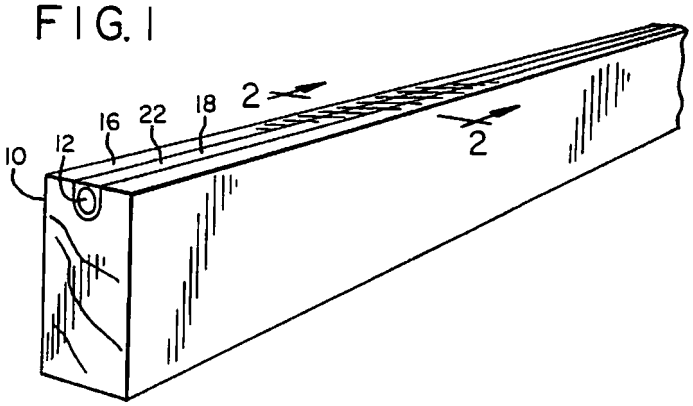


FIG. 2

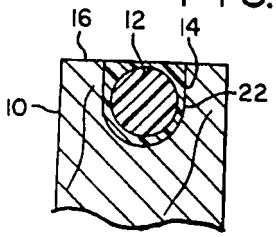


FIG. 3

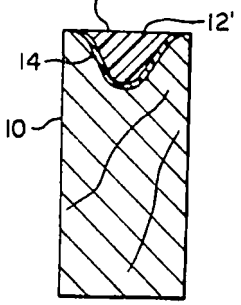


FIG. 4

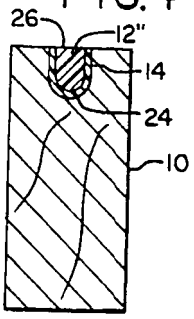


FIG. 5

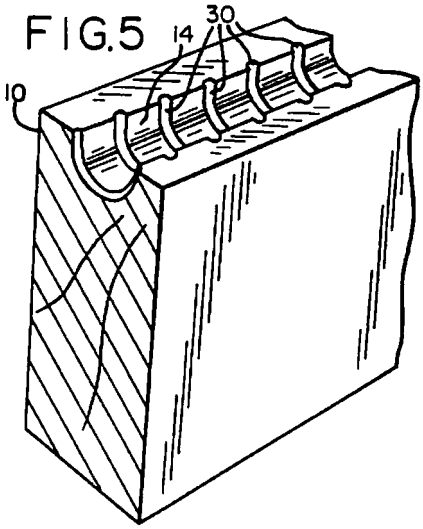


FIG. 6

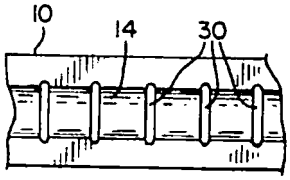


FIG. 7

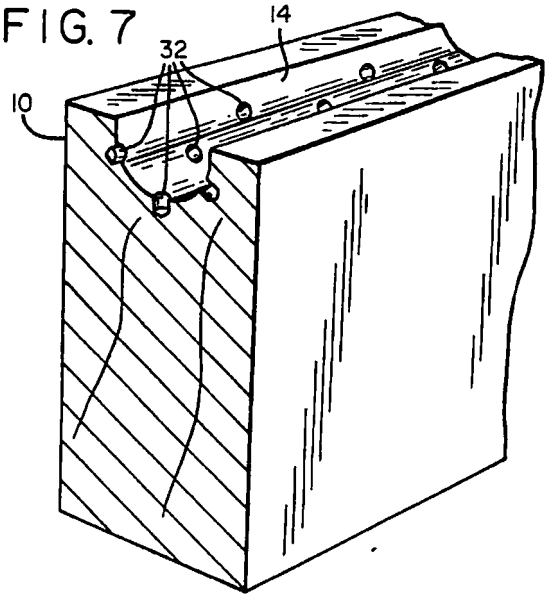


FIG. 8

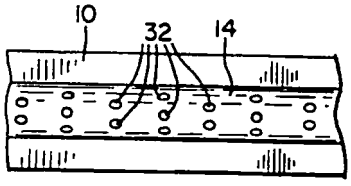
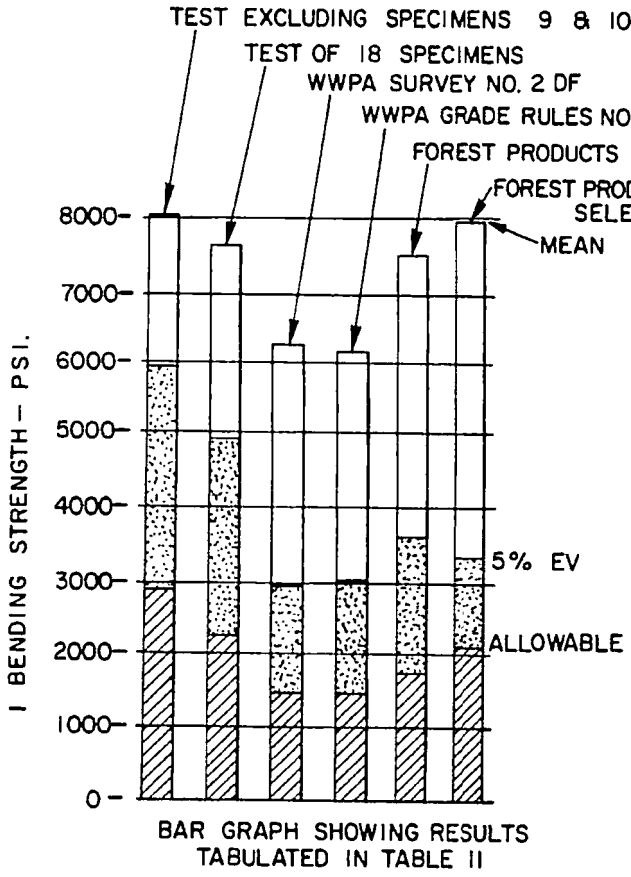


FIG. 9



BAR GRAPH SHOWING RESULTS TABULATED IN TABLE II

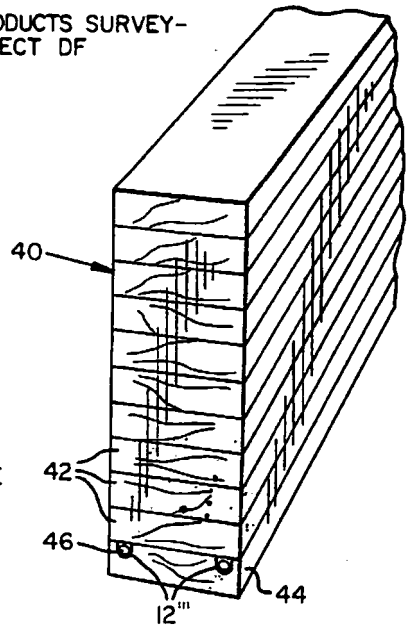
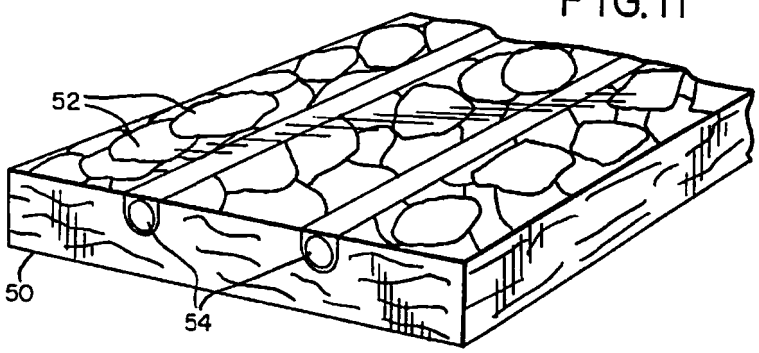


FIG. 10

FIG. 11



REINFORCED LUMBER

FIELD OF THE INVENTION

This invention relates to reinforced structural members and, more particularly, to beams of wood or wood-constructed products reinforced with permanently affixed glass fiber-polyester rods.

BACKGROUND OF THE INVENTION

While wood has many desirable qualities that make is useful for structural members, use of sawn lumber for structural members also creates several difficulties because of some inherent problems. First of all, wood timbers are inherently nonuniform in their structural characteristics. The presence of knots and the location thereof from one structural member to another can cause great variation in the structural strength of a member. The location of the wood of a structural member within a tree can cause a variation in its characteristics from a member that is taken from a different portion of the tree. Moreover, high grade structural quality wood timbers are becoming increasingly more expensive as the supply of old growth, virgin trees nears exhaustion. The second growth trees from which more and more lumber is originating tend to have more knots and other defects which makes it less suitable for structural purposes.

Because of the wide disparity in the strength of wooden structural members, several difficulties in the use of such members are created. First, the structural members must be carefully graded, and any members that have apparent weakening defects must be rejected or downgraded which, of course, decreases their commercial value substantially. Second, because of the increasing scarcity of high grade wood structural members, they are becoming increasingly more expensive. Moreover, because of the wide variation in structural strength existent even within a carefully graded lot of wooden structural members, in order to ensure an adequate safety margin, larger members or an increased number of members have to be specified than would be the case if the structural strength fell within a narrower range.

Previous attempts to increase the strength of wooden structural support members have been made. For example, U.S. Pat. No. 3,717,886 discloses a bed frame with reinforced slats consisting of a flat, rolled steel reinforcing member attached to the bottom face of a wooden slat member. In U.S. Pat. No. 3,294,608 a wood beam is prestressed and a steel plate bonded to the surface under tension. However, although suitable for use in small scale applications, such systems could not function economically under large-scale construction conditions. Besides the high cost of manufacture and the additional weight, such composites would present fastening problems and are not adapted to be cut to shorter lengths with the usual wood-working equipment. Likewise, prestressed elements have been used to reinforce structural members. For example, U.S. Pat. No. 3,533,203 discloses the use of stretched synthetic ropes to apply a compressive force to such diverse items as concrete beams, aluminum pipe and ladder rails, the stretched element being attached by clamps or similar means to the member. U.S. Pat. No. 3,890,097 discloses the manufacture of fiber board wherein fiberglass strands are embedded in the matrix as the board is laid up and held under tension until the resin has set and in U.S. Pat. No. 4,312,162 tension is applied to steel or fiberglass strands laid up along the side of a fiberglass light pole until a resin matrix sets to bind the strands of the pole.

In U.S. Pat. No. 3,251,162 a series of rods or cables pass through a laminated beam and are connected to tensioning plates and bolts at either end. Similarly, in U.S. Pat. No. 3,893,273, a vertical rod tensioned at either end is set in the edge of a door. U.S. Pat. No. 4,275,537 discloses a whole series of truss assemblies composed in each case of multiple parts, in which the basic principle is the use of pre-stressed or pre-loaded elements, such as tensioned cables or steel straps to accomplish reinforcement.

These prior procedures and products each have inherent disadvantages. The disadvantage of steel and like reinforcing material has already been discussed. The manufacture of products where one or more elements must be held under tension is inherently expensive. In constructions of multiple parts, a total product is produced, such as a ladder, a door or a truss which must be used as a whole. Thus, none of the patents cited permit easy cutting to size at the job site to suit the needs of the job.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide a structurally reinforced wooden beam member designed to overcome inherent weaknesses resulting from natural wood defects and that can be manufactured economically.

An object of the invention is to produce reinforced lumber of significantly enhanced structural strength, uniformity and utility which can be handled at the job site exactly as ordinary lumber.

Another important object of the present invention is to provide wooden beams with structural reinforcements that do not require prestressing techniques in their manufacture.

More particularly, it is an object to provide a wooden beam member reinforced with one or more fiberglass/resin rods adjacent a longitudinal surface of the beam whereby the ultimate strength of the beam is substantially increased.

Another object of the invention is to provide a method of reinforcing wooden beam members whereby a lot of such members will have less disparity in the range of ultimate strength of such members.

It is another object of this invention to provide reinforced wooden beam members having long-lasting resistance to aging and natural weakening processes.

It is a further object of the present invention to provide wooden beam members structurally reinforced with glass fiber-resin rods.

It is a still further object of this invention to provide reinforced wooden beam members which maintain high levels of tensional strength when cut into shorter lengths.

Other objects and features of the present invention will become apparent hereinafter.

In accordance with the illustrated embodiment of the invention, a wooden beam member is provided with one or more grooves adjacent a surface which will be in tension under load. In each of these grooves is placed a preformed glass fiber-resin rod preferably of equal length as the wooden beam member. The rod is securely affixed to the beam within a groove, using a resin-based adhesive material. A beam reinforced in such manner

exhibits a substantial increase in ultimate strength as compared to non-reinforced wood beams and reinforced beams exhibit much less variation in their strength. Moreover, shortening of the beam by cutting off a portion does not destroy the beneficial effect of the reinforcement on the remaining length of the beam.

For a more detailed description of the invention, reference is made to the accompanying drawings and following description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a reinforced wooden member made in accordance with the invention;

FIG. 2 is an enlarged cross-sectional view taken along line 2—2 of FIG. 1;

FIGS. 3 and 4 are fragmentary perspective views of further modifications of the present invention;

FIG. 5 is a perspective view of a wooden beam member showing a groove with notches designed to facilitate contact between said groove surfaces and resin adhesive;

FIG. 6 is a plan view of the notched groove embodiment as shown in FIG. 5;

FIG. 7 is a perspective view of the wooden beam member showing a groove with holes designed to facilitate contact between said groove surfaces and resin adhesive;

FIG. 8 is a plan view of the embodiment shown in FIG. 7; and

FIG. 9 is a bar graph illustrating certain features of the invention.

FIG. 10 is a view of a laminated beam illustrating how reinforcing members may be incorporated therein; and

FIG. 11 is a view of a plank formed of wood flakes incorporating reinforcing members in accordance with the invention.

DETAILED DESCRIPTION

Referring first to FIG. 1, a wood beam 10 is illustrated having an unstressed circular glass fiber reinforced polyester rod 12 positioned in a round bottomed groove 14 formed in a surface 16 of the beam member. While the invention is generally applicable to wood beams sawn directly from logs and will be particularly described with respect to such sawn beams, the reinforcing system herein described is also applicable to beams formed by laminating smaller boards and to structural members formed of wood flakes bonded with a suitable resin. "Wood beams" herein embraces all of these. The rod 12 preferably extends longitudinally for the entire length of the beam 10, as illustrated, but may for some purposes be of shorter length. As shown in FIG. 2, the groove 14 is of such depth that the uppermost surface 18 of the rod 12 is substantially flush with the beam surface 16. The reinforcement rod 12 is permanently affixed in groove 14 with a resin-based adhesive 22, e.g., ATACS Products, Inc. K114-A/B, an epoxy-type resin. Prior to application of the adhesive, the surface of rod 12 may be abraded, if necessary, to facilitate adherence of the adhesive. To assure good and complete adhesion, the surface of the groove 14 and the rod 12 are both coated with the adhesive before the rod 12 is inserted. The groove 14 is preferably formed with a curved bottom surface complementary to rod 12, the width and depth of the groove being such as to admit the rod with a clearance substantially equal to the preferred glue line thickness, i.e., about 0.007".

As shown in FIGS. 3 and 4, the cross-sectional shape of the embedded rod may be selectively varied. For example, FIG. 3 illustrates a beam having a generally triangular rod 12' embedded therein, the rod being positioned with a rounded bottom side down and a flat side 25, extending parallel to and flush with the beam surface, with groove 14' being shaped to complement rod 12'. FIG. 4 shows a beam having a rod 12" in a so-called "bull nose" configuration having a semicircular embedded edge 24 and a flat top surface 26 parallel with the beam surface. The groove 14" is shaped to conform to the rod 12".

Physical modifications of the groove in some instances facilitate adhesion between the rod 12 and groove 14 surface. For example, as shown in FIGS. 5 and 6, transversely extending notches 30 may be formed in the groove 14 walls and bottom. Similarly, as shown in FIGS. 7 and 8, a plurality of holes 32 may be drilled or punched in the bottom of groove 14. The grooves and/or holes effect greater adhesion between the beam 10 and rod 12 by keying the cured resin to the wood thus reducing the likelihood of any longitudinal shifting between the beam and rod when the beam is bent under load.

Illustrated in FIG. 10 is a beam 40 formed by laminating smaller wood sections 42 in the conventional manner. However, in accordance with the invention the laminating layer 44 near one edge of the beam is formed with one or more grooves 46, two being illustrated, in each of which a fiberglass rod 12"' is glued.

FIG. 11 illustrates a flake board plank 50 formed by laying up wood flakes indicated at 52 with a bonding resin and compressing the mass while resin sets in the usual manner. One face of the plank 50 is formed with a pair of grooves in which are bonded fiberglass rods 54. Flake board products are notably weak in tensile strength and the presence of reinforcing rods 54 will enhance the tensile strength of the face in which they are embedded thereby enlarging the utility of such products.

EXAMPLE I

A load test conducted on members constructed in accordance with the invention disclosed herein provides evidence of its value and effectiveness. Eighteen eight-foot long 2×4's of mill-run No. 2 grade Douglas fir selected at random from a shipment of 156 pieces were each provided a lengthwise-extending 17/64" wide, round bottomed groove in one edge thereof. Bonded in the grooves were ¼" diameter rods of a pultruded type consisting of 70–75% glass fiber, combined with polyester resin binders. The surface of each groove and rod was coated with an epoxy resin before placement of the rods in the grooves. The surface of each rod was abraded to facilitate adhesion of the resin. The resin adhesive used was an epoxy resin manufactured by the Fiber Resin Corporation.

Each reinforced 2×4 was tested on a 90-inch span, the 2×4's being positioned with the reinforced edge facing downwardly. Test loads were positioned at third points on the reinforced 2×4's. The load rate for the tests was 0.5 inches per minute in accordance with ASTM Standard D198. Upon structural failure of each 2×4, the load involved was measured and recorded. The moisture content of the specimens varied from 10 to 14 percent, averaging about 12 percent. The specific gravity of the specimens averaged 0.44 and ranged from 0.39 to 0.52, oven dry weight and green volume basis.

Table I shows the ultimate bending strength for each of the eighteen reinforced specimens.

TABLE I

Ultimate Bending Strength of Reinforced No. 2 Douglas Fir 2 × 4's	
Specimen No.	UBS-(psi)
1	9902
2	7353
3	6618
4	9118
5	9314
6	6961
7	9069
8	8579
9	4559
10	4215
11	8676
12	7640
13	5980
14	9607
15	7255
16	7848
17	6813
18	7647
Mean =	7620

Thereafter, the methods of analysis as indicated in ASTM D2555 and parts of ASTM D2915 were used to analyze the data received. This procedure of analysis uses elementary statistical theory based on the ordinary Student's "t". This theory estimates that the upper and lower boundaries of 90 percent of a normal distribution of the population from which an 18 specimen sample is randomly chosen are equal to the mean plus or minus 1.74 times the standard deviation.

The standard deviation, computed from the 18 piece sample is the square root of the sum of the squares of the individual test values' deviation from their mean. The mean is denoted $\overline{X}$, and the standard deviation is denoted as s. "t" is a statistical quantity for estimating the boundaries and it varies with the size of the sample, and the percentage of the population included within the limits.

No. 2 grade softwood lumber has a reasonably normal symmetrical distribution about the mean. Thus, the boundaries are:

$$\text{Upper limit} = \overline{X} + ts = 7620 + 1.74\,(1616) = 10{,}431 \text{ psi}$$

$$\text{Lower limit} = \overline{X} - ts = 7620 - 1.74\,(1616) = 4{,}808 \text{ psi}$$

This lower limit exceeds the lowest 5% of the strength values of this population since 90% occur between the upper and the lower boundaries and 5% exceed the upper boundary. This lower limit is called lower 5% exclusion value (5% EV). The usual practice in establishing allowable strength is to determine this stress, which excludes the lowest five percent of the population.

The estimated allowable stress (EAS) or design strength was calculated using the ASTM formula:

$$\text{EAS} = 5\%\ \text{EV}/2.10 = 4860/2.1 = 2314 \text{ psi.}$$

Similar calculations were made for the mean bending strength computed omitting the UBS values for samples 9 and 10. As will be noted, samples 9 and 10 broke at very low values. Subsequent examination indicated that there was an inadequate curing of the resin in these specimens. Thus, for some comparisons as made below, these two specimens were excluded as being non-representative. The remaining sixteen specimens had a mean bending strength of 8054 psi.

The results for the reinforced specimens were compared to data obtained from a Western Wood Products Association (WWPA) survey on the stress capacity of non-reinforced grade-run No. 2 Douglas fir 2×4's and to standards for such 2×4's established under WWPA Lumber Grading Rules (1981). The data for the WWPA survey came from a carefully conducted study of in-grade lumber properties designed in consultation with the U.S. Forest Products Laboratory. This study utilized a 440 piece sample.

Because similar WWPA survey results are unobtainable for No. 1 Douglas fir and Select Structural Douglas fir, the results were also compared to survey results for No. 1 and select Douglas fir contained in a Forest Products Laboratory Research Paper dated June, 1983, entitled "Characterizing the Properties of 2-inch Softwood Dimension Lumber with Regressions and Probability" by William L. Galligan, Robert J. Hoyle, Roy F. Pellerin, James H. Haskell and James W. Taylor (not yet in published form). Table II shows the results from these tests as compared with the results from the WWPA survey and with the values derived from the WWPA estimated allowable stress for No. 2 Douglas fir, and with the results of the Forest Products Laboratory Research Paper.

TABLE II

			Comparison for 2 × 4's			
	For 18 Reinforced No. 2 Douglas Fir 2 × 4's	For 16 Selected Reinforced No. 2 Douglas Fir 2 × 4's	WWPA Survey Results for No. 2 Douglas Fir 2 × 4's	WWPA Rules for No. 2 Douglas Fir 2 × 4's	Forest Prods. Lab Research Paper Info for No. 1 Douglas Fir 2 × 4's	Forest Prods. Lab Research Paper Info for Select Structural Douglas Fir 2 × 4's
Mean Bending Strength (psi)	7620	8024	6300	6233*	7523	7953
Standard Deviation (psi)	1616	1178	2001	1932*	2332	2008
5% Exclusion (psi) Value	4808	5963	2998*	3045*	3674	3313
Estimated Allowable Stress (psi)	2290	2839	1428	1450	1750	2100

*Calculated using a "t" coefficient = 1.65

The WWPA Rules specify, as indicated in Table II, an estimated allowable stress of 1450 psi for No. 2 grade Douglas fir. By calculation, the 5% EV=2.1×1450=3045 psi. Assuming a coefficient of variation=0.31, (i.e., s=0.31X), the calculated mean bending strength, $\overline{X}$, can be calculated as follows:

$\bar{X}-0.31\bar{X}t=5\%$ EV=3045 psi
$\bar{X}-0.31\bar{X}(1.65)=3045$ psi
X=6233 psi

In some of the selected sixteen specimens there was evidence of some slippage between the rod and the 2×4 indicating an incomplete resin cure in these also so that it is possible they failed at a lower load than if there had been no slippage. Even so, the mean or average ultimate bending strength of 8,024 psi for the representative sixteen specimens compares with a mean bending strength of 6,300 psi for the samples in the WWPA survey. Thus, these sixteen specimens reinforced in accordance with the invention exhibited a mean bending strength twenty-seven percent greater than the average of the WWPA tests. The ultimate bending strength of these same specimens surpassed that of No. 1 and Select Structural Douglas fir as shown in the Forest Products Laboratory research paper.

Even including test specimens 9 and 10, the mean bending strength for all eighteen specimens was 7,620 psi, or twenty-one percent greater than the WWPA survey average, and twenty-two percent greater than the calculated mean strength under the WWPA Rules.

Moreover, the tests indicated that the reinforced 2×4's of the invention have substantially less deviation in strength. The tests indicated that, using the values of the sixteen members mentioned above, the standard deviation was 1178 psi. In the WWPA survey, the deviation was 2001 psi. Thus, the deviation of these sixteen test members was fifty-nine percent of the standard deviation found in the 440 2×4's tested in the WWPA survey. Even with the two lowest members included, the standard deviation for all eighteen members was 1616 psi, or about eighty-one percent of the WWPA survey average. For the sixteen selected reinforced pieces, the standard deviations are fifty-one percent and fifty-nine percent, respectively, of those for No. 1 and Select Structural Douglas Fir as disclosed in the Forest Products Laboratory research paper.

The 5% EV/2.1 value (estimated allowable stress) for the sixteen members was 2,839. For the eighteen, it was 2,290. These are about ninety-nine percent and sixty percent larger, respectively, than the WWPA Rule Book value of 1,450 psi. In fact, these values exceed the WWPA Grade Rule values of 1,750 psi for No. 1 2×4's by sixty-two and thirty-one percent, respectively, and the WWPA Grade Rule value of 2,100 psi for select structural by thirty-five percent and nine percent, respectively.

In summary, the sixteen specimens reinforced in accordance with the invention not only appreciably increase the mean bending strength for No. 2 Douglas fir shown by the WWPA survey, but also surpass that of No. 1 and Select Structural Douglas fir, at the same time showing markedly less standard deviation than No. 2, No. 1 and Select Structural Douglas fir, and widely surpassing the estimated allowable stress of all three grades. In essence, the invention brings about this result; that No. 2 lumber reinforced in accordance with the invention outperforms not only unreinforced No. 2, but also No. 1 and Select Structural grades, permitting significant upgrades in the utility of lumber.

EXAMPLE II

Five No. 2 grade 2×8 Douglas fir planks twelve feet in length selected at random from a larger lot were reinforced along one edge in the same manner as the 2×4's of Example I with a ¼" diameter pultruded glass fiber rod extending the full length of the plank. These planks were tested on a 135" span, the 2×8's being positioned with the reinforced edge facing downward, with the test load applied at third points, the load rate again being 0.5 inches per minute. Table III shows the results of these tests compared to the WWPA survey on 390 Douglas fir 2×8's and the WWPA Rule Book value for No. 2 Douglas fir 2×8's. In addition, the table includes data from the aforementioned Forest Products Laboratory survey.

TABLE III

		Comparison for 2 × 8's			
	For 5 Reinforced No. 2 Douglas Fir 2 × 8's	WWPA Survey Results for No. 2 Douglas Fir 2 × 8's	WWPA Rules for No. 2 Douglas Fir 2 × 8's	Forest Prods. Lab Research Paper Info for No. 1 Douglas Fir 2 × 8's	Forest Prods. Lab Research Paper Info for Select Structural Douglas Fir 2 × 8's
Mean Bending Strength (psi)	6872	5594	5374*	7456	8008
Standard Deviation (psi)	1721	2390	1665*	2609	2566
5% Exclusion Value (psi)	3396	1663	2625*	3550	3814
Estimated Allowable Stress (psi)	1527	792	1250	1500	1800

*Coefficient of variation assumed = 0.31

The mean bending strength of these tested specimens exceeded the average ultimate strength of the WWPA survey specimens by twenty-three percent. The standard deviation of 1721 psi was twenty-eight percent less than that for the WWPA survey for No. 2 Douglas fir, and sixty-six percent and sixty-seven percent, respectively, of the standard deviation for No. 1 and Select Structure Douglas fir. The 5% exclusion value was computed using a "Student's 't'" coefficient of 2.13 because of the small sample size. The WWPA survey used a coefficient of 1.65 because of the larger sample. Based on these calculations, the estimated allowable stress exceeded the WWPA survey results by 193 percent (1527 vs. 792) and the WWPA Rule Book value by twenty-nine percent (1527 vs. 1250), surpassing also the estimated allowable stress for No. 1 Douglas fir.

As was the case with 2×4 Douglas fir, the reinforcement comprising the invention materially enhances the structural character of No. 2's and produces favorable comparisons with the superior No. 1 and Select Structural grades.

The data tabulated in Table II is set forth graphically in FIG. 9. The substantial improvement in the strength of 2×4's reinforced in accordance with the invention is readily apparent. The top of the cross-hatched portion

indicates the allowable stress, the top of the stippled portion the 5% EV values, and the top of each bar the mean bending strength.

These tests show that practice of the invention can significantly improve structural wood members. Not only can the invention significantly improve the ultimate strength of wood structural members, but it also reduces significantly the variability of the strength in such members. These improvements have the effect of upgrading the reinforced members enabling the members to be used under higher design loads than for non-reinforced members. It also enables the use of lower grade stock to attain members of a desired level of strength. The reduction in deviation permits design of structures to closer load tolerance. The economic significance of these advantages is clearly apparent and it is achieved utilizing a relatively inexpensive glass fiber-resin rod secured relatively inexpensively to the wooden member.

The reinforcing rods may be positioned in both the top and bottom surfaces of a member and likewise could be utilized in the tension or compression edges of glued-laminated beams.

While only a few embodiments of the present invention have been shown and described, it will be apparent many changes and modifications can be made hereto without departing from the spirit and scope of the invention.

We claim:

1. A composite integral structural support member adapted to be cut to the desired length, if necessary, and incorporated into a load bearing structure for the purpose of accepting at least a portion of the load imposed upon such structure, said member comprising a wooden beam, a groove of predetermined depth longitudinally disposed within a surface of said wooden beam, and an unstressed nonwood, nonmetallic reinforcing rod adhesively fixed within said groove whereby said support member has an ultimate strength greater than that of said wooden beam.

2. The structural support member of claim 1 wherein the surface of said reinforcement rod is abraded.

3. The structural support member of claim 1 wherein the exposed surfaces of said rod, after affixation, are no higher than the plane formed by adjacent surfaces of said wooden beam.

4. A reinforced structural support member comprising a wooden beam, a groove of predetermined depth longitudinally disposed within a surface of said wooden beam, and an unstressed reinforcing rod of glass fibers bonded with a polyester resin adhesively affixed within said groove.

5. The structural support member of claim 4 wherein said rod is circular in cross-section and said groove is formed with a complementarily-shaped bottom surface.

6. The structural support member of claim 4 wherein said reinforcement rod and said groove each are of generally triangular cross-sectional configuration.

7. The structural member of claim 4 wherein said reinforcement rod has a bull-nosed cross-sectional configuration, and said groove is of complementary cross-section.

8. The structural support member of claim 7 wherein the exposed surface of said reinforcement rod is substantially coplanar with the adjacent surfaces of said wooden beam.

9. A structural support member as in claim 4 wherein said wooden beam is a single wooden piece.

10. A structural support member as in claim 4 wherein said wooden beam comprises wood flakes bonded by a resin.

11. A structural support member as in claim 4 wherein said wooden beam is laminated from smaller wood pieces.

12. A reinforced structural support member comprising a wooden beam, a groove of predetermined depth longitudinally disposed within a surface of said wooden beam, a plurality of holes in the bottom of said groove, and an unstressed reinforcing rod adhesively affixed within said groove.

13. A reinforced structural support member comprising a wooden beam, a groove of predetermined depth longitudinally disposed within a surface of said wooden beam, a plurality of notches in the wall of said groove extending in a direction transverse to the longitudinal axis of said groove, and an unstressed reinforcing rod adhesively affixed within said groove.

* * * * *

Appendix 2B – U.S. Patent 4,095,913 "Pettersson et al."

United States Patent [19]

Pettersson et al.

[11] **4,095,913**

[45] **Jun. 20, 1978**

[54] TONGUE AND GROOVE JOINT

[76] Inventors: Nils Ingvar Pettersson, Bruksvagen 31, 752 41 Uppsala; Olle Gideon Carlsson, Brillingevägen 3, 754 45 Uppsala, both of Sweden

[21] Appl. No.: 729,998

[22] Filed: Oct. 6, 1976

[30] Foreign Application Priority Data

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Jun. 14, 1976	Germany	2626530
Jun. 14, 1976	United Kingdom	24613/76

[51] Int. Cl.[2] B25G 3/02

[52] U.S. Cl. 403/364; 52/593; 403/248

[58] Field of Search 403/277, 282, 283, 345, 403/296, 364, 32, 248; 52/593, 595, 573, 514, 98; 285/DIG. 26

[56] References Cited

U.S. PATENT DOCUMENTS

1,018,828	2/1912	Johnson	403/345
1,163,784	12/1915	Skinner	403/345 X
1,785,499	12/1930	Sayers	52/437 X
1,989,955	2/1935	Van Patter	403/377 X
2,981,669	4/1961	Brand et al.	403/282 X
3,079,730	3/1963	Donegan	52/595 X
3,482,865	12/1969	Haller	403/282
3,998,024	12/1976	Frandsen	52/595

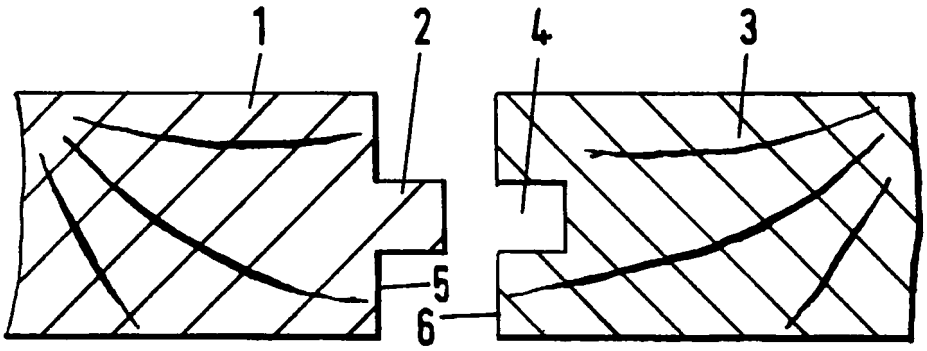
Primary Examiner—Wayne L. Shedd

Attorney, Agent, or Firm—Witherspoon, Lane & Hargest

[57] ABSTRACT

In a tongue and groove joints the base of the groove is provided with one or more protuberances to space the tongue from the base of the groove. If the members forming the joint are such that they swell when moist the protuberances are made to be deformable to permit the members to swell without deforming the structure made from the members.

5 Claims, 6 Drawing Figures



(PRIOR ART)

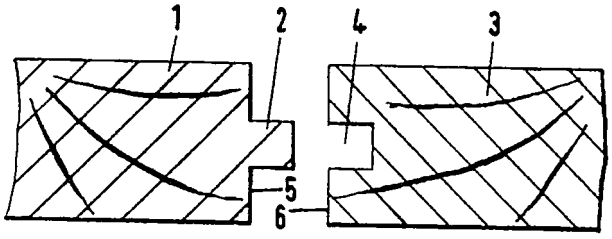


FIG.1. (PRIOR ART)

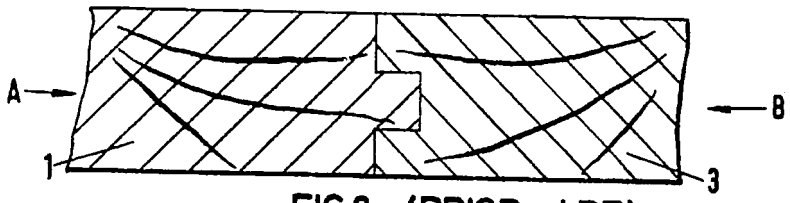


FIG.2. (PRIOR ART)

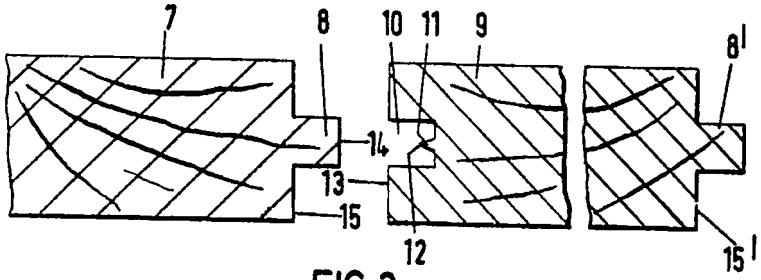


FIG. 3.

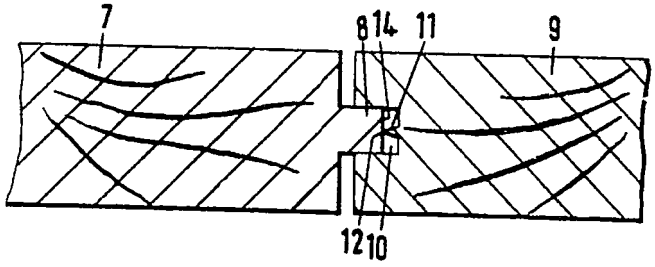


FIG. 4.

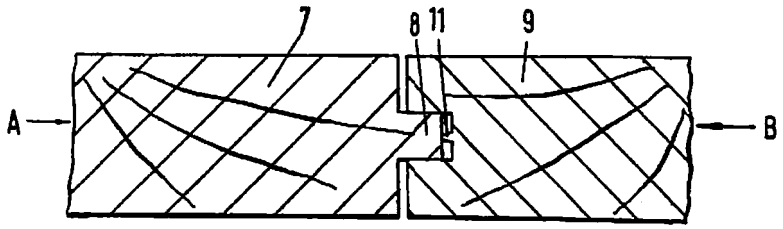


FIG. 5.

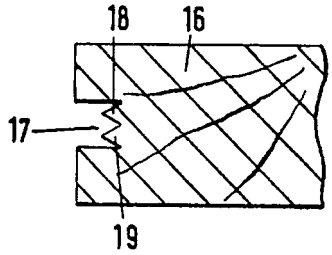


FIG. 6.

TONGUE AND GROOVE JOINT

FIELD OF THE INVENTION.

The present invention relates to a tongue and groove joint, and more particularly to a tongue and groove joint between planks, boards, panels or the like.

BACKGROUND OF THE INVENTION.

A tongue and groove joint between adjacent planks boards or panels is well known, and at the present time the use of planks provided with tongues and grooves on opposed side edges thereof is common in the formation of floors for houses or other such buildings. In laying such a floor the tongue provided on one side edge of one plank is inserted into a corresponding groove provided on one side edge of an adjacent plank, and the tongue and groove are of substantially the same size so that when the tongue and the groove have been interconnected the two planks are substantially rigidly interconnected and also the joint between the planks is substantially draught-proof.

Tongue and groove joints are also utilised in many other applications, and are utilised in connection with planks made of wood, panels or boards made of chipboard or other such materials, and even with larger panels, such as panels formed of concrete or the like.

Planks boards and panels made of wood, chipboard or the like tend to expand when they are wet, or when used in a moist atmosphere. When planks boards or panels interconnected by means of tongue and groove joints are utilised in damp conditions, the planks or boards expand and, for example, in the case of floor, the planks may become distorted and may move from their original position so that the floor is no longer planar. Similar distortions occur in other structures formed from panels or boards having tongue and groove connections, particularly items such as garage doors. More particularly this has been found to be a particular problem in connection with garage doors or tongue and groove panels or the exterior of a house where, of course, the planks panels or boards are frequently subjected to conditions of high humidity.

OBJECT OF THE INVENTION.

The present invention seeks to provide a tongue and groove connection in which the above described disadvantages are obviated or reduced, and the invention relates to a member provided with a groove adapted to receive a tongue, and also the invention relates to a member provided with a groove adapted to receive a tongue, and also provided with a tongue adapted to be received within a groove of a corresponding such member.

Another object of the invention is to provide a tongue and groove joint which can absorb expansion of the boards panels or planks constituting the joint.

SUMMARY OF THE INVENTION.

According to one aspect of this invention there is provided a member adapted to be connected to another member by means of a tongue and groove joint, said member being provided with a groove, said groove being provided with a spacer member therein adjacent the base thereof, said spacer member being adapted to space a tongue from the base of said groove.

According to another aspect of this invention there is provided a member adapted to form a tongue and groove joint with another member, said member being provided, on one edge thereof, with a groove, said groove being provided with a spacer member in the form of one or more protuberances extending inwardly from the base of said groove, said protuberances being formed integrally with the material forming the member.

It will be appreciated that by utilising the invention a predetermined spacing is achieved between adjacent members, thus permitting some subsequent expansion of the members. During such expansion the spacer member will be deformed or compressed.

BRIEF DESCRIPTION OF DRAWINGS.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated the invention will now be described by way of example with reference to the accompanying drawings in which:-

FIG. 1 is a sectional view of two prior proposed planks, one provided with a tongue, and one provided with a groove;

FIG. 2 is a sectional view of the two planks illustrated in FIG. 1 interconnected to form a tongue and groove joint;

FIG. 3 is a sectional view of two members adapted to form a tongue and groove joint in accordance with the present invention;

FIG. 4 is a sectional view of the two members illustrated in FIG. 3 when assembled to form a tongue and groove joint;

FIG. 5 is a sectional view of the two members forming the tongue and groove joint as illustrated in FIG. 4 after the members have been subjected to moisture; and

FIG. 6 is a sectional view of part of a further member showing a second form of groove.

DESCRIPTION OF PRIOR ART AND THE INVENTION.

Referring now to FIG. 1 in a tongue and groove joint as presently utilised, a board or panel of wood 1 is provided with a rectangular section tongue 2 on one side edge 5 thereof. A second board or panel 3 is provided with a rectangular groove 4 on the side edge 6 thereof facing the tongue 2. The tongue 2 and the groove 4 are of substantially the same size and thus when the boards or panels 1 and 3 are connected to form a tongue and groove joint, as illustrated in FIG. 2, the side wall 5 of the board 1 carrying the tongue 2 engages with the side wall 6 of the board 3 provided with the groove 4. Also the tip of tongue 2 engages with the base of the groove 4. When such boards or panels are subjected to moisture the boards or panels tend to expand in the direction of the arrows A and B of FIG. 2. Since the boards or panels are substantially rigidly interconnected by the tongue and groove connection there is no "give" and consequently the boards or panels tend to buckle or bow.

FIG. 3 illustrates one embodiment of the present invention. A plank, board or panel 7 is provided with a rectangular tongue 8, this tongue corresponding precisely with the tongue 2 of the prior art. A second plank, board or panel 9 is provided with a generally rectangular groove 10 in one side wall 13 thereof, and the groove 10 is provided with a protuberance 11 which extends inwardly from the base of the groove 10. The protuberance 11 is formed integrally of the material forming the plank, board or panel, and the groove and

protuberance may be formed in one operation by using an appropriate routing tool. The second plank board or panel 9 is provided with a tongue 8' on the side face thereof 15' remote from the groove 10.

In the particularly described and illustrated embodiment the protuberance 11 is of triangular section and is situated symmetrically on the base of the groove.

The distance between the tip 12 of the protuberance 11 and the face 13 of the plank board or panel 9 is less than the distance between the tip 14 of the tongue 8 and the face 15 of the plank board or panel 7.

When the planks boards or panel 7 and 9 are assembled to form a tongue and groove joint, as illustrated in FIG. 4, of the accompanying drawings, the tip 12 of the protuberance 11 engages with the end face 14 of the tongue 8, and thus the tongue 8 is not wholly introduced to the groove 10. However, a substantially draught-proof and substantially rigid connection between the boards 7 and 9 is obtained. The face 13 of the plank board or panel 9 does not contact the face 15 of the plank board or panel 7. When the panels or boards 7 and 9 are subjected to moisture the boards or panels expand and forces are generated as indicated by the arrows A and B shown in FIG. 5. The protuberance 11 is formed so that it is relatively weak, compared with the overall strength of the tongue 8, this being because the protuberance 11, at the tip thereof, has less thickness than the overall thickness of the tongue 8. Thus the end portion or tip of the protuberance 11 collapses as a result of the forces applied to the protuberance by the tongue 8, and thus the boards or panels 7 and 9 are permitted to expand slightly, thus preventing planks boards or panels from becoming bowed. This relative movement of the planks boards or panels may continue until the faces 13 and 15 come into contact, or until the protuberance 11 will not provide any more "give".

FIG. 6 illustrates a further embodiment of the invention in which a plank board or panel 16 is provided with a groove 17, there being two substantially triangular protuberances 18, 19 provided on the base of the groove 17, the protuberances being symmetrically arranged and being each of generally triangular cross-section.

Whilst the invention has been described with reference to substantially triangular protuberances provided on the base of the groove, it is to be noted that the protuberances may be of any shape or form and may be provided at any convenient place within the groove. The protuberance or protuberances act as spacer members, and act to space the tongue from the base of the groove. The protuberance or protuberances are preferably of a compressible or deformable nature and thus provide some "give" to prevent the planks boards or panels from becoming distorted in damp or moist conditions.

The planks panels or boards illustrated in the accompanying drawings may comprise wood, chipboard, fibreboard or any other such material.

It is also to be appreciated that the invention may also be applied to members of concrete or the like, where it is desired to obtain a predetermined spacing between adjacent members.

I claim:

1. A first member adapted to form a tongue and groove joint with a second member, said first member being provided, with means defining a groove on one edge thereof said groove having two parallel sides and a base transverse thereto, said groove being provided with a spacer member in the form of a protuberance extending into said groove from its base, said protuberance being formed integrally with the material forming the member, said second member being provided on an edge thereof opposed to said edge provided with said groove, with a tongue, said protuberance being adapted to space said tongue from said base of said groove, wherein the distance between the innermost part of said protuberance and said edge in which said groove is formed is less than the distance between the tip of said tongue and said edge on which said tongue is formed.

2. A member as claimed in claim 1 wherein the said protuberance is of triangular section.

3. A member as claimed in claim 1 wherein said protuberance is compressible.

4. A member as claimed in claim 1 wherein said protuberance is deformable.

5. A member as claimed in claim 1 wherein said protuberance is located symetrically on said base of said groove.

* * * * *

Appendix 2C – U.S. Patent 2,926,729 "Zanini"

March 1, 1960 L. ZANINI 2,926,729

PROCESS TO EMBODY WOODEN LATHS WITH COATING OF PLASTIC MATERIAL

Filed Sept. 25, 1956

Fig. 1

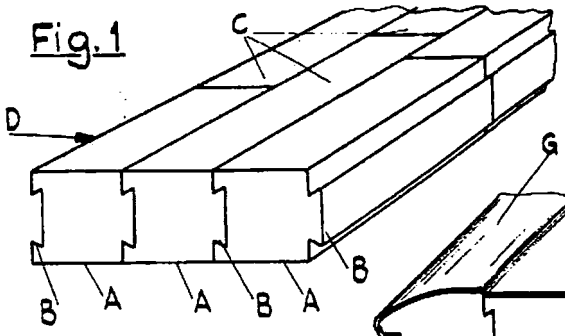


Fig. 2

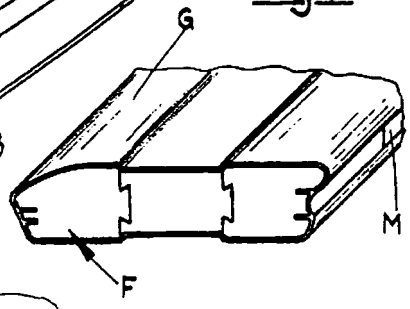


Fig. 3

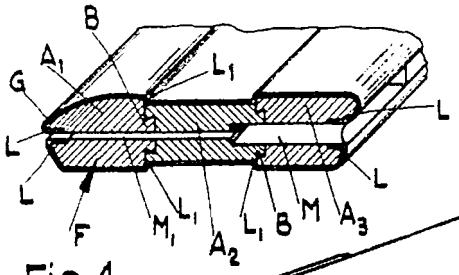


Fig. 4

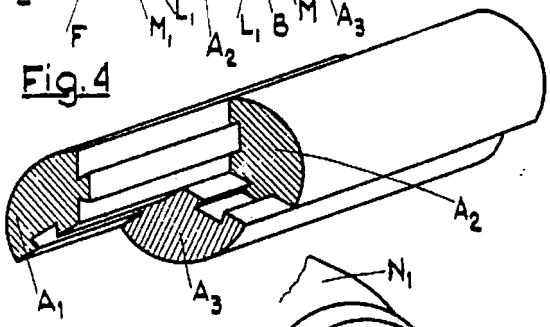


Fig. 5

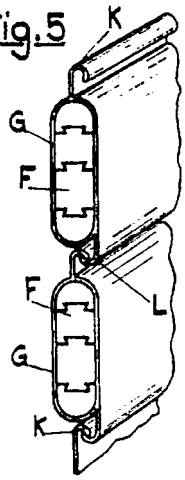
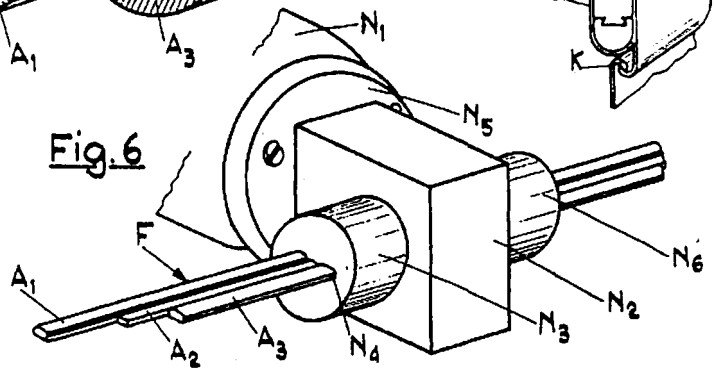


Fig. 6



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Att.

United States Patent Office 2,926,729 Patented Mar. 1, 1960

2,926,729

PROCESS TO EMBODY WOODEN LATHS WITH COATING OF PLASTIC MATERIAL

Luigi Zanini, San Dona di Piave, Italy

Application September 25, 1956, Serial No. 611,839

Claims priority, application Italy April 7, 1956

1 Claim. (Cl. 160—236)

This invention relates to a process to embody laths, formed of a core of wood and supplied with a coating of plastic material.

With special, but not exclusive reference to the Venetian blinds or the like with wooden laths, the manufacturing of these laths causes a very great number of rejects, since the laths have to be of one piece only and without knots, crevices or the like. Therefore, the manufacturing of wooden laths for Venetian blinds usually gives occasion to considerable losses and rejects.

The invention proposes to employ strips of wood of any lengths to embody laths of any desired length, making use, should it occur, of the rejects which result from the wood working and which were heretofore unused, in order to obtain a coated profile piece of an indefinite length, from which may be obtained, the laths of the length as desired.

The feature of the process characterizing this invention is the fact to make in the core of the lath grooves or the like, within which the plastic material forming the coating, for at least part of said core, enters under pressure and is therein bounded and anchored.

According to the invention, the wooden elements or bands forming the core of the lath are connected and interlocked and then the elements are shaped, coated with a plastic material, and then from the continuous element the laths of the length desired are cut off.

In order to secure the plastic coating of the core and at the same time to tighten in condition of coaction the various strips forming the core itself, core grooves or the like are made in strips, within which the plastic material, entering under pressure, is anchored therein, thus bonding the strips together.

Advantageously, at least part of the grooves are made substantially in correspondence with the junctions between the various elements forming the lath, so that the plastic material, wedging within said slots, may permit to embody a system of resilient co-action, maintained in such state by the plastic coating.

The lath embodied according to the process which has been above specified, is characterized by a core, formed of wooden bands, suitably connected between them, which core is at least in part arranged and held in place by a sheath or casting of suitable material coating.

Advantageously, the coating sheath is applied to the wooden core with a certain strength, in order to coactively hold up said core, and in particular, the wooden bands forming the core itself, so as to secure the structure and the monolithic quality of the lath.

The invention also relates to a device to carry out the said process, permitting the continuous coating of the laths with plastic material.

The invention will now be explained by the following description, referring to the accompanying drawing, the last one illustrating, in an exemplifying way, some forms of embodiment of the lath according to the invention.

In the drawing:

Fig. 1 shows a perspective view of a composite lath blank, obtained by means of the union of elementary wooden, strips, and from which composite lath blanks are later obtained the laths for Venetian blinds.

Fig. 2 is a perspective view of a lath obtained from the composite lath blank, according to Fig. 1.

Fig. 3 is a section, made in correspondence with one of the openings for the passage of the coupling elements for the various laths.

Fig. 4 is a perspective view of a lath, shaped as stick.

Fig. 5 shows as a perspective view a section of Venetian blind, in which the individual laths are interconnected.

Fig. 6 is a perspective view of the device for coating the laths with a thermoplastic material.

With reference to Fig. 1, to embody the lath as illustrated, one proceeds in the following manner. Wooden strips even rejects or discards from other working are selected so as to remove the more considerable flaws and then submitted to a calibration machining.

Precisely, the elementary strips A are supplied, on one or two of their opposed longitudinal faces, with conjugated or dovetailed recesses B, in order to obtain interlocking connections.

The strips so obtained, the length of which may be limited, too, as compared with the finished lath, are connected between them, paying attention to the fact that the junctions C between the various strips are staggered.

Thus one embodies a composite lath blank D, the single elements A of which are formed of wooden strips, without flaws, as for instance cracks, fissures and so forth.

Strips A are shaped in a plain and quick way by means of a suitable machine, permitting, besides the formation of the tongues and recesses B, the simultaneous calibration of said strips, too, so as to obtain, easily and quickly, blanks D.

Blanks D obtained are then submitted to a shaping, in order to obtain laths F with the outline as desired. Or in an advantageous way, set of strips are embodied (in the case illustrated in Figs. 2 and 3 said strips are three), each of which is first shaped with the due profile, in order to obtain shaped laths which are coupled between them in continuity to embody core F. In the case of Figs. 2 and 3, the three elements of the set are stated as A_1, A_2 and A_3, and said set is formed of a certain number of shaped strips which are interlocked.

This solution permits, as it will be said later on, the quick and rational manufacturing of laths F of an endless length, being sufficient to connect in succession elementary strips A_1, A_2 and A_3 with lath obtained F.

In lath F so obtained will be made then longitudinal, or transverse grooves, for the objects which now will be said.

Advantageously, these grooves may be made in the complete lath F, before coating said lath with sheath G, for instance by means of tools, to be used before the entrance of the lath into the coating device, which will be described later on.

Precisely, as illustrated in Fig. 3, pairs of longitudinal grooves L are foreseen, made in correspondence with the ends of the lath. The reciprocal distance of each groove from the one conjugated is made so as to admit the embodiment between said grooves of the usual openings M—M_1, for the passage of the linking members of the laths.

Furthermore, in the wooden lath or core F are made other longitudinal fissures L_1, foreseen in correspondence or in proximity of the engaging surfaces between the various sequences of elementary bands A_1, A_2 and A_3. These grooves may be designed under a square, so as to guarantee ulteriorly the anchoring of sheath G or coating.

Core F so obtained is then supplied with coating G. According to this invention, this coating is formed of

plastic material, which is applied to lath F by means of extrusion.

The device, applying this coating to laths F, is formed (see Fig. 6) of a worm conveyor, rotating in a pertinent cylinder N_1, to convey and compress the plastic material towards an extrusion head N_2, supplied with suitable heating means. Said head presents then, in correspondence with its transverse ends, a guiding plate N_3, presenting an opening N_4, shaped substantially as the transverse section of the lath to be coated.

Head N_2 is hollow inside and connected by means of suitable couplings with the outlet opening N_5 of worm conveyor N_1. The core part of head N_2 is closed by a drawing die N_6, which presents a profile, reproducing the final profile and contours of the lath. The consequence is that core F is introduced, through suitable forwarding rollers, with regularity and continuity, into the extrusion head N_2, where said core is supplied with coating G.

The plastic and fluid material, present under pressure in head N_2, is made adherent to all the outline of said core, and in correspondence with grooves L and L_1, such plastic material is introduced by force, and therein anchored.

The consequence is that such fluid material, introduced in said grooves, specially in those L_1, actuates in the elementary bands A stresses, which are opposed to those actuated in core F by coating or sheath G. Then, when core F, coming out coated from drawing plate N_6, and, as the sheath is gradually cooling, said coating is subject to a condition of co-action, rendering monolithic the structure obtained or lath, and of such a capacity to be able to efficaciously resist to the mechanic stresses.

This condition of a monolithic quality of the lath is maintained even after effecting in said lath openings M for the passage of the linking elements. On the contrary, one will notice that the coating sheath G remains intimately adherent with core F, even if openings M—M_1 present a certain dimension, since such openings, although discontinuing partially the peripheric continuity of coating G, prevent this last one to get off the core, thanks to the provision of the pairs of grooves L, in which the plastic material has wedged and therein have set, which grooves may be inclined, as compared with the planes of the lath.

Furthermore, the lath so obtained may present the aesthetic features as wanted, since the coating material may be selected of the colour as desired. Besides, the junctions between the various elementary laths A, specially the longitudinal ones, may be easily disguised, foreseeing in correspondence with such junctions some rabbets, the side ends of which coincide with the junction surface, as shown in Fig. 3.

From drawing plate N_6, a continuously coated lath of indefinite length is drawn, since its core F is formed of elementary bands A_1, A_2 and A_3, which are of an indeterminate length. From this lath, then, may be obtained, by means of a simple cutting operation, the laths of the length as desired, which are afterwards submitted to the usual completing and finishing operations; in particular, such laths are supplied in the usual way with openings M, M_1.

The conception as it has been now explained and pertinent to the possibility of uniting and coating wooden bands in order to obtain the laths characteristic of the invention, allows to embody laths provided with members for their mutual hinged connection, for instance as required in case of laths for Venetian blinds. As shown in Fig. 5, sheaths G of each lath F_1 present at their ends ribs K—L, to be conjugated between them and forming the members for the mutual connection of the laths.

Obviously, these ribs may be more or less shaped, in order to embody laths, to be suitably displaced between them and allow the passage of the light through openings.

It appears clear that the lath so obtained, besides presenting a pleasant look, has its own structure, which is resistant to mechanical stresses to which the Venetian blinds are subject. In a particular way, its sheath, being embodied of plastic material, is especially resistant to deleterious atmospheric agents, and therefore renders unnecessary the customary paintings, often required by the usual Venetian blinds.

Furthermore, and always thanks to the coating sheath G, the Venetian blinds so obtained may easily be subject to cleaning by means of a water jet, removing all the deposits, thanks to the smooth surface, presented by the coating sheath.

As shown by Fig. 4, the section of the lath may be a circular one, and the core of such a lath is formed of sets of bands A_1, A_2 and A_3, mutually linked between them by means of dovetail junctions B.

What I claim is:

A lath comprising a plurality of elongated strips, means interlocking said strips in side by side abutting engagement, said strips including a center strip disposed between outer strips, said center strip being of a reduced cross sectional dimension with said outer strips being of greater thickness than said center strip, said center strip having grooves therein adjacent the juncture thereof with the adjacent outer strips, dovetail tongues on said strips, dovetail recesses in said strips oppositely disposed from said tongues, said tongues being interlockingly engaged in the recesses of adjacent strips, and a coating bonded to and entirely covering said strips and extending into said grooves maintaining said strips in interlocked arrangement.

References Cited in the file of this patent

UNITED STATES PATENTS

517,348	Linderman	Mar. 27, 1894
1,939,041	Cherry	Dec. 12, 1933
2,091,012	Pratt	Aug. 24, 1937
2,104,307	Miller	Jan. 4, 1938
2,112,861	Hagen et al.	Apr. 5, 1938
2,229,225	Schneider	Jan. 21, 1941
2,275,975	McGlone	Mar. 10, 1942
2,659,932	McNamee	Nov. 24, 1953

FOREIGN PATENTS

464,792	Italy	July 21, 1951

Appendix 2D – U.S. Patent 5,165,816 "Parasin"

US005165816A

United States Patent [19]

Parasin

[11] Patent Number: 5,165,816

[45] Date of Patent: Nov. 24, 1992

[54] TONGUE AND GROOVE PROFILE

[75] Inventor: Alexander V. Parasin, Vancouver, Canada

[73] Assignee: Council of Forest Industries, North Vancouver, Canada

[21] Appl. No.: 657,585

[22] Filed: Feb. 15, 1991

[51] Int. Cl.[5] F16B 11/00; E04F 15/04

[52] U.S. Cl. 403/334; 403/381; 403/345; 52/595

[58] Field of Search 403/381, 334, 364, 333, 403/375, 345, 361; 52/595, 593, 589

[56] References Cited

U.S. PATENT DOCUMENTS

1,214,261	1/1917	Balbach	403/345
2,267,330	12/1941	Goss	403/334 X
2,823,433	2/1958	Kendall	52/589
2,839,790	6/1958	Collings	52/589
2,895,753	7/1959	Fentiman	403/381
3,579,941	5/1971	Tibbals	52/593 X
3,791,082	2/1974	Bowling	52/593
4,633,275	12/1986	Hubbard et al.	403/333 X
4,807,416	2/1989	Parasin .	

FOREIGN PATENT DOCUMENTS

914370	4/1972	Canada .	
910153	11/1962	United Kingdom	403/364

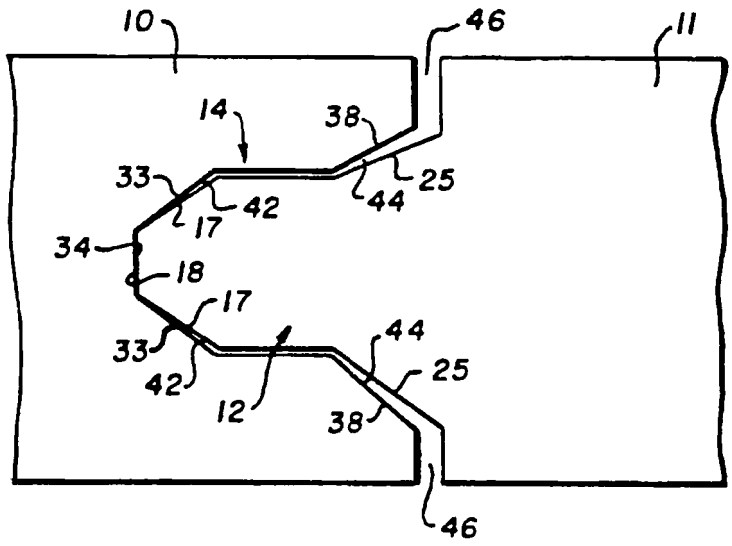
Primary Examiner—Peter M. Cuomo

Attorney, Agent, or Firm—Townsend and Townsend

[57] ABSTRACT

A tongue and groove construction panel in which the tongue comprises a protruding extension formed on a first edge of the panel. The tongue has a head with chamfered sides that expand from a narrowed tip to a neck having essentially parallel sides. The neck merges into a shoulder portion having chamfered sides that expand to merge with the panel. The groove comprises a correspondingly shaped cavity formed on a second edge. The groove has a head with chamfered sides that expand from a base to a neck having parallel sides that merge into a shoulder portion having chamfered sides that expand to a groove opening. The tongue and groove have adjacent chamfered head and shoulder surfaces in an assembled joint. The chafered surfaces of the tongue are disposed at a more acute angle than the chamfered surfaces of the groove to leave spaces therebetween in an assembled joint. The tongue tip is substantially smaller than the mouth of the groove opening to allow easy penetration of the tongue head into the groove shoulder. Furthermore, the tongue tip is substantially smaller than the neck of the groove to allow easy penetration of the tongue head into the groove neck.

7 Claims, 1 Drawing Sheet



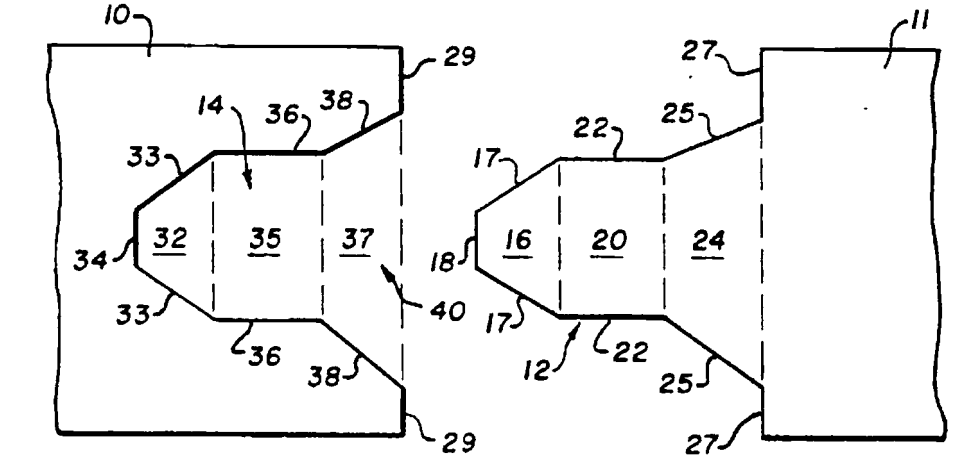

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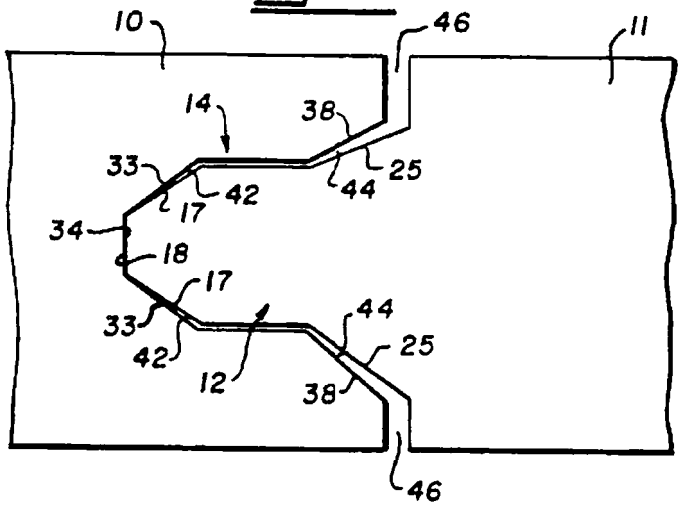
Fig. 1.

Fig. 2.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TONGUE AND GROOVE PROFILE

FIELD OF THE INVENTION

This invention relates to wood based panels having a tongue and groove configuration on their side edges. The tongue and groove arrangement of the present invention can be formed on plywood panels, oriented strandboard, waferboard, particleboard and fiberboard.

BACKGROUND OF THE INVENTION

Wood based panels are commonly used in building industry as floor sheathing and flat roof sheathing. When used in these applications, panels are preferably formed with some sort of tongue and groove profile to allow for quick and efficient interlocking of the panels during construction. The panels span the distance between supporting joists with the interlocking tongue and groove side edges of adjacent panels serving to support the panels against deflection between the joists while the end edges of the panels are located over and supported by the joists.

Canadian Patent 914,370 which issued to applicant discloses a tongue and groove profile for a plywood panel suitable for use as a floor or flat roof panel. Patent 914,370 discloses a tongue and groove profile in which the inner walls of the groove are essentially parallel except for the inner most region adjacent the groove base adapted to accommodate the tongue tip. The opening or clearance of the groove is only slightly larger than the thickness of the tip of the tongue. As a result of this arrangement, it can become very difficult to insert the tongue into the groove during the installation process, particularly if the panel edges are slightly wavy or bowed or if the edge profiles are swollen due to an increased moisture content.

U.S. Pat. No. 4,807,416 which also issued to applicant, discloses a tongue and groove profile having a twin wedge configuration that makes the installation of a swollen profile easier. However, as the resulting joint dries out after installation, the tongue will tend to shrink creating play in the joint that leads to differential deflections between the profiled edges of adjacent panels, greater than acceptable for flooring type of panels.

Also, some profiles used in oriented strandboard and waferboard are of a single wedge-like shape and while they make the installation of a swollen profile somewhat easier, the swelling prevents the tongue from reaching the bottom of the groove and after drying out while installed, a large tolerance between the groove and tongue results, and may cause excessive differential deflections between the profiled edges of the adjacent panels, unacceptable or undesirable for flooring applications.

SUMMARY OF THE INVENTION

The present invention provides a tongue and groove construction panel that addresses the problems of the prior art.

The present invention provides a tongue and groove construction panel in which the tongue comprises a protruding extension formed on a first edge of the panel having a head with chamfered sides that expand from a narrowed tip to a neck having essentially parallel sides, said neck merging into a shoulder portion having chamfered sides that expand to merge with the panel, and the groove comprises a correspondingly shaped cavity formed on a second edge having a head with chamfered sides that expand from a base to a neck having parallel sides that merge into a shoulder portion having chamfered sides that expand to a groove opening, said tongue and said groove having adjacent chamfered head and shoulder surfaces in an assembled joint, said chamfered surfaces of said tongue being disposed at a more acute angle than the chamfered surfaces of said groove to leave spaces therebetween in an assembled joint.

The tongue and groove panel of the present invention incorporates an edge profile that performs significantly better than previous profiles used until now on wood based panel products. A panel according to the present invention facilitates very easy installation of profiled panels while limiting the differential deflection between edges of adjacent panels to a minimum. Using the edge profile of the present invention, even panels with bowed, somewhat wavy or swollen, or with slightly damaged edges can be easily interlocked together.

Wood based panels constructed according to the present invention find particular application as floor and flat roof sheathing in that easy installation is permitted, considerable loads are transferred by the tongue and groove joint, and the differential deflection between edges of joined panels is minimal.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated, merely by way of example, in the accompanying drawings in which:

FIG. 1 shows the tongue and groove edges of a preferred embodiment of the present invention; and

FIG. 2 shows the panels of FIG. 1 after assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there are shown two panels 10 and 11 which are similar in all respects, each having a tongue 12 along one side edge and a groove 14 formed in the opposite side edge.

Tongue 12 comprises a protruding extension formed on a first edge of panel 11. There is a head 16 with chamfered sides 17 that expand from a narrowed tip 18 to a neck 20 having essentially parallel sides 22. Neck 20 merges into a shoulder portion 24 having chamfered sides 25 that expand to merge with the side edge 27 of panel 11.

Groove 14 is a correspondingly shaped cavity to accept tongue 12 formed along side edge 29 of panel 10. Panel 10 has a matching tongue formed on its opposite side edge, just as panel 11 has a matching groove formed on its opposite side edge. Groove 14 is formed with a head 32 having chamfered sides 33 that expand from a base 34 to a neck 35 having parallel sides 36 that merge into a shoulder portion 37 having chamfered sides 38 that expand to a groove opening 40.

FIG. 2 shows panels 10 and 11 in an assembled state. Tongue 12 and groove 14 have adjacent chamfered head surfaces 17 and 33, and shoulder surfaces 25 and 38 in an assembled joint. The chamfered surfaces of tongue 12 are disposed at a more acute angle than the chamfered surfaces of groove 14 to leave spaces therebetween in an assembled joint.

In the profile of the present invention, tongue tip 18 is substantially smaller than mouth 40 of the groove opening to allow easy penetration of the tongue head 16 into the groove shoulder area 37. The wide mouth 40 with its inwardly directed sides 38 ensures that tongue head 16 is aligned for groove neck 35. This also allows for an

easy initial penetration of the tongue head into the shoulder of the groove even when the profiles are swollen, wavy, bowed or slightly damaged.

In addition, tongue tip 18 is substantially smaller than the neck 35 of groove 14 to allow easy penetration of the tongue head into the groove neck.

In an assembled joint, the adjacent essentially parallel sides of tongue neck 20 and groove neck 35 cooperate to act as load bearing surfaces to prevent undesirable movement of one panel edge with respect to the engaged adjacent panel edge. The design of the present tongue and groove profile is such that tongue neck 20 is always able to engage in groove neck 35 to some extent even if tongue 12 is swollen to prevent full penetration.

When assembling joints, glue may be applied to the tongue and groove profiles, the application of glue is optional. The spaces 42 between the tongue head and the groove head chamfered surfaces define a gap to accommodate excess glue. Alternatively, if glue is not used, space 42 will accommodate debris and dirt which may be pushed forward by the penetrating tongue.

Adjacent chamfered tongue shoulder surfaces 25 and groove shoulder surfaces 38 define spaces 44 to accommodate panel expansion and contraction in an assembled joint.

In addition, tongue 12 is preferably longer than groove 14 is deep such that when tongue tip 18 engages groove base 34 spaces 46 are created between joined panel edges 27 and 29 to allow for further expansion and contraction of the joint.

It will be understood that the tongue and groove profile of the present invention can be used on a variety of wood based panel products such as plywood, oriented strandboard (OSB), waferboard, particleboard and fiberboard. In the case of plywood and OSB, the face grain is usually positioned perpendicular to a series of supporting joists. In the case of waferboard and other panels, the length of the panel is positioned perpendicular to the joists. The panel ends are located over and joined at the joists. The tongue and groove profiles of the present invention are provided along the longer edges of adjacent panels to interlock the panels together and also serve to transfer the load from one panel to another thereby increasing the edge stiffness of the system, lowering the overall deflection of the edge portions of the panels and preventing excessive deflection of one panel edge with respect to the adjacent panel edge. If not controlled, excessive deflection may can lead, through a scissor effect, to cutting of finishing material laid on the panels.

Although the present invention has been described in some detail by way of example for purposes of clarity and understanding, it will be apparent that certain changes and modifications may be practiced within the scope of the appended claims.

I claim:

1. A tongue and groove construction panel in which the tongue comprises a protruding extension formed on a first edge of the panel having a head with chamfered sides that expand from a narrowed tip to a neck having essentially parallel sides, said neck merging into a shoulder portion having chamfered sides that expand to merge with the panel, and the groove comprises a correspondingly shaped cavity formed on a second edge having a head with chamfered sides that expand from a base to a neck having parallel sides that merge into a shoulder portion having chamfered sides that expand to a groove opening, said tongue and said groove being dimensioned to interfit such that the neck of said tongue fits within the neck of said groove with clearance and adjacent chamfered head and shoulder surfaces in an assembled joint are spaced apart to leave gaps about said tongue to ensure ease of insertion.

2. A tongue and groove panel as claimed in claim 1 in which said tongue tip is substantially smaller than the mouth of said groove opening to allow easy penetration of said tongue head into the groove shoulder.

3. A tongue and groove panel as claimed in claim 1 in which said tongue tip is substantially smaller than the neck of said groove to allow easy penetration of the tongue head into the groove neck.

4. A tongue and groove panel as claimed in claim 1 in which said adjacent chamfered tongue head and groove head surfaces define a gap to accommodate excess glue in an assembled joint.

5. A tongue and groove panel as claimed in claim 1 in which said adjacent chamfered tongue shoulder and groove shoulder surfaces define a gap to accommodate panel expansion and contraction in an assembled joint.

6. A tongue and groove panel as claimed in claim 1 in which said tongue is longer than said groove is deep such that when said tongue tip engages said groove base a space is created between the joined edges of the panels to allow for expansion and contraction.

7. A tongue and groove panel as claimed in claim 1 in which said tongue and groove are formed with load bearing surfaces comprising the parallel sides of said tongue and groove neck.

* * * * *

Appendix 2E – WO 99/40273 "Olofsson"

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(74) Agent: STENBERG, Yngve; Perstorp AB, S-284 80 Perstorp (SE).

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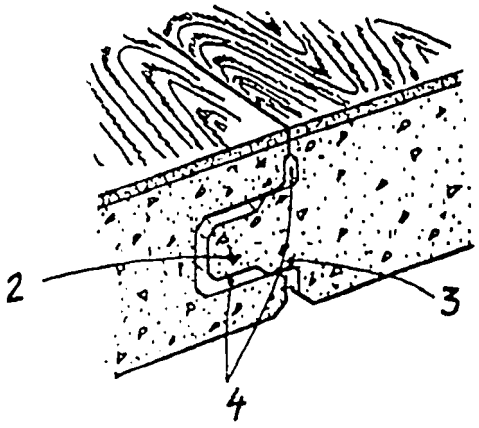
(54) Title: GUIDING MEANS AT A JOINT

(57) Abstract

A guiding means at a joint comprising groove (1) and tenon (2) preferably intended to be joined with glue. The tenon (2) and/or groove (1) includes guiding wedges (3).



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Guiding means at a joint.

The present invention relates to a guiding means at a joint comprising groove and tenon, preferably intended to be joined with glue.

Prefabricated floorboards which at their edges are provided with groove and tenon are well known nowadays. As these are very easy to install it is possible for the normal handy man to achieve this. These type of floors can be constituted of massive wood, fibre board or particle board. These are often provided with a surface layer, such as lacquer or some sort of laminate. The boards are most often installed by gluing them together via their groove and tenon. It is desired to join the separate boards so closely that the joint becomes practically invisible, which increases the moisture resistance radically. The usable life of the installed floor is hereby also increased. In order to achieve a tight joint, it is essential that glue is used excessively. The clearance in the joint will therefore have to be relatively large in order to be able to force the boards together without having to use special equipment due to the forces that would be needed otherwise. A to small clearance will cause a hydraulic resistance caused by the glued captured inside the groove during the joining. The clearance needed will however cause a random discrepancy in the levels between adjacent floorboards. This discrepancy in levels will lead to an increased wear at the joint and that moisture may penetrate the joint. The decorative wear layer, often constituted by lacquer or laminate will hereby often be worn down closest to the joint. The wood fibre will hereby be naked closest to the joint, which in addition to be being unsightly also may cause the fibres to swell when exposed to moisture. This causes the surface layer to rise closest to the edges whereby these edges will be exposed to further wear, which will decrease the useful life of the floor radically.

It has, through the present invention, quite unexpectedly been possible to solve the above mentioned problems so that the risk for error during installation is radically reduced, whereby the average usable life of the floor, with a guiding means according to the present invention, is considerably increased. Accordingly, the invention relates to a guiding means at a joint comprising groove and tenon preferably intended to be joined with glue. The invention is characterised in that the tenon and/or groove includes guiding wedges. The guiding means preferably forms a part of boards intended to, together form a floor. The core of the boards is constituted by a fibre board or a particle board. At least the upper side of the board is constituted by a decorative thermosetting laminate. The fitting clearance between the tenon and the groove includes a first fitting clearance and a second, guiding, fitting clearance. The second, guiding, fitting clearance is obtained through the guiding

wedges. The first fitting clearance comprises the main part of the fit and the second, guiding fitting clearance comprises a smaller part of the fit. The first fitting clearance is in the range 0.1 - 1 mm, preferably 0.1 - 0.5 mm, while the second, guiding, fitting clearance is in the range 0.01 - 0.2 mm, preferably 0.02 - 0.1 mm.

According to one embodiment of the invention the guiding wedges are arranged perpendicular to the extension of the joint.

According to another embodiment of the invention the guiding wedges are arranged parallel to the extension of the joint.

The surfaces of the joint is provided with recesses so that cavities are formed in the joint. The cavities are intended to receive the glue used during the joining.

The invention is further illustrated together with enclosed figures showing different embodiments of the invention whereby,

-figure 1 shows, in perspective view, a first embodiment of a guiding means at a joint, according to the invention.

-figure 2 shows, in perspective view, the embodiment form figure 1 after assembly.

-figure 3 shows, in perspective view, a second embodiment of a guiding means at a joint, according to the invention.

-figure 4 shows, in perspective view, a third embodiment of a guiding means at a joint, according to the invention.

Accordingly, figure 1 shows, in perspective view seen from above, a first embodiment of a guiding means at a joint according to the invention. The guiding means comprises groove 1 and tenon 2 which usually is intended to be joined by using glue. The tenon 2 comprises guiding wedges 3 on the upper and lower sides. The fitting clearance between the groove 1 and tenon 2 includes a first and a second, guiding, fitting clearance, which second, guiding, fitting clearance is obtained by the guiding wedges 3. The first fitting clearance forms the main part of the fit while the second, guiding, fitting clearance forms a smaller part of the fit. The first fitting clearance is approximately 0.2 mm while the second, guiding fitting clearance is approximately 0.05 mm. The guiding wedges 3 are arranged parallel to the extension of the joint. The same embodiment is shown assembled in figure 2.

The respective surfaces of the joint are provided with recesses so that cavities 4 are formed in the joint. The cavities 4 are intended to receive the glue used at the assembly. The guiding means comprises a part of boards intended to, together form a floor whereby the core of the board is constituted by fibre board or a particle board and at least the upper side of the board is constituted by a decorative thermosetting laminate.

Figure 3 shows, in perspective view seen aslant from above, a second embodiment of a guiding means at a joint, according to the invention. The embodiment conforms in the main with the one described in connection to figure 1 and 2. The tenon 2 is, however, provided with guiding wedges arranged perpendicularly to the extension of the joint.

Figure 4 shows, in perspective view seen aslant from above, a third embodiment of a guiding means at a joint, according to the invention. The embodiment is shown assembled. The embodiment corresponds in the main to the one described in connection to figure 1 and 2, the tenon 2 is however provided with guiding wedges 3 only at the lower side.

The invention is not limited by the embodiments shown since these can varied in different ways within the scope of the invention. Guiding wedges 3 can, for example, be arranged inside the groove 1. If these guiding wedges 3 are parallel to the extension of the joint, they are suitably arranged in the bottom of the groove 1 while they can be given a shape similar to the one shown in figure 3 if they are arranged perpendicularly to extension of the joint.

CLAIMS

1. A guiding means at a joint comprising groove (1) and tenon (2) preferably intended to be joined with glue c h a r a c t e r i s e d in that the tenon (2) and/or groove (1) includes guiding wedges (3).

2. A guiding means according to claim 1 c h a r a c t e r i s e d in that the fitting clearance between the tenon (1) and the groove (2) includes a first fitting clearance and a second, guiding, fitting clearance, which second, guiding, fitting clearance is obtained through the guiding wedges (3), whereby the first fitting clearance comprises the main part of the fit and the second, guiding fitting clearance comprises a smaller part of the fit, that the first fitting clearance is in the range 0.1 - 1 mm, preferably 0.1 - 0.5 mm, while the second, guiding, fitting clearance is in the range 0.01 - 0.2 mm, preferably 0.02 - 0.1 mm.

3. A guiding means according to claim 1 or 2 c h a r a c t e r i s e d in that the guiding wedges (3) are arranged perpendicular to the extension of the joint.

4. A guiding means according to claim 1 or 2 c h a r a c t e r i s e d in that the guiding wedges (3) are arranged parallel to the extension of the joint.

5. A guiding means according to any of the claims 1 - 4 c h a r a c t e r i s e d in that the surfaces of the joint is provided with recesses so that cavities (4) are formed in the joint, which cavities (4) are intended to receive the glue used during the joining.

6. A guiding means according to any of the claims 1 - 5 c h a r a c t e r i s e d in that the guiding means forms a part of boards intended to, together form a floor, whereby the core of the boards is constituted by a fibre board or a particle board and that at least the upper side of the board is constituted by a decorative thermosetting laminate.

Fig. 1

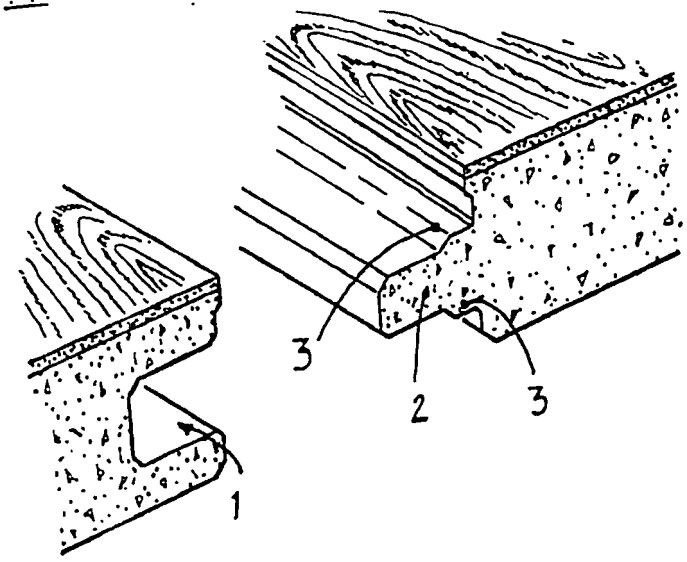


Fig. 2

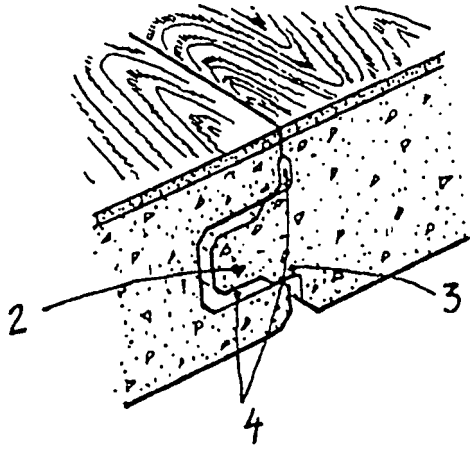


Fig. 3

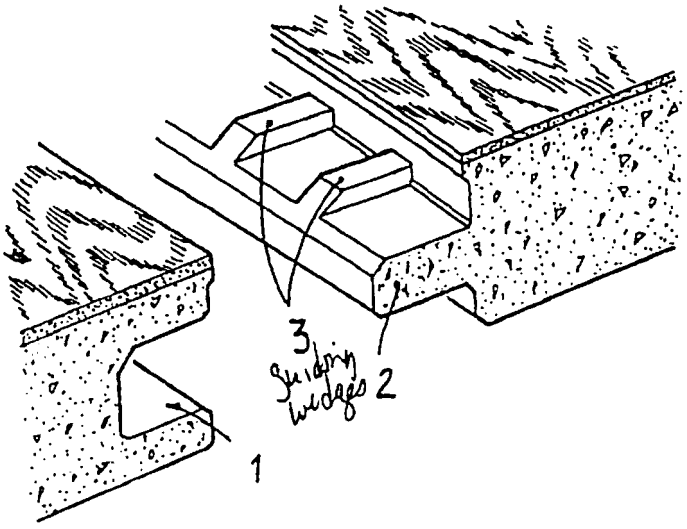
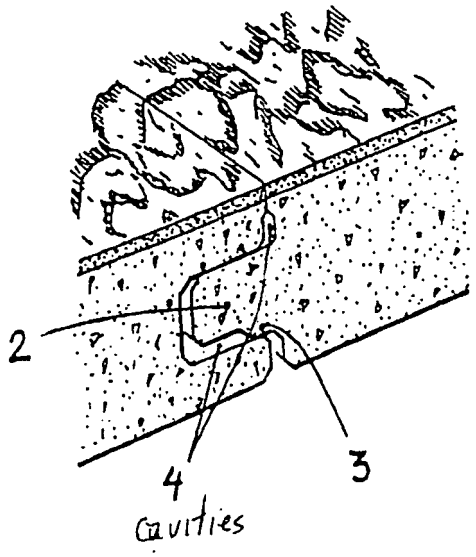


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/00128

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: E04F 15/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: E04F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5165816 A (A.V. PARASIN), 24 November 1992 (24.11.92)	1,4
Y		5,6
A		2,3
	--	
Y	WO 9747834 A1 (UNILIN BEHEER B.V.), 18 December 1997 (18.12.97)	5,6
A		1-4
	--	
A	US 752694 A (J.G.F. LUND), 23 February 1904 (23.02.04)	1-6
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/00128

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9627721 A1 (PERSTORP FLOORING AB), 12 Sept 1996 (12.09.96)	1-6

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Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/SE 99/00128

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5165816 A	24/11/92	CA 2036029 A,C	09/08/92
		GB 2269875 A,B	23/02/94
WO 9747834 A1	18/12/97	AU 3256997 A	07/01/98
		BE 1010339 A	02/06/98
		BE 1010487 A	06/10/98
		BG 102230 A	30/09/98
		CA 2226286 A	18/12/97
		CN 1195386 A	07/10/98
		CZ 9800391 A	12/08/98
		DE 29710175 U	14/08/97
		EP 0843763 A	27/05/98
		NO 980569 A	10/02/98
		PL 324923 A	22/06/98
		SI 9720009 A	31/08/98
		SK 16398 A	09/09/98
US 752694 A	23/02/04	NONE	
WO 9627721 A1	12/09/96	AU 4960096 A	23/09/96
		BR 9607272 A	23/06/98
		CA 2213757 A	12/09/96
		CN 1177390 A	25/03/98
		EP 0768929 A	23/04/97
		EP 0813641 A	29/12/97
		JP 10502303 T	03/03/98
		JP 11501377 T	02/02/99
		NO 974110 A	06/11/97
		SE 9500810 D	00/00/00

Appendix 2F – U.S. Patent 5,497,595 "Kalinin"

US005497595A

United States Patent [19]

Kalinin

[11] Patent Number: 5,497,595

[45] Date of Patent: Mar. 12, 1996

[54] METHOD OF REINFORCING WOOD BEAMS AND WOOD BEAMS MADE THEREFROM

[76] Inventor: Daniel Kalinin, 1779 Grosvenor Place, Mississauga, Ontario, Canada, L5L 3V8

[21] Appl. No.: 292,015

[22] Filed: Aug. 18, 1994

[51] Int. Cl.[6] E04C 3/292

[52] U.S. Cl. 52/737.3; 52/309.16; 52/730.7; 52/731.1

[58] Field of Search 52/730.7, 821, 52/309.2, 309.16, 737.3, 731.1, 745.19

[56] References Cited

U.S. PATENT DOCUMENTS

1,084,276	1/1914	Jaminet	52/821 X
3,605,360	10/1971	Lindal	52/730.7 X
4,281,497	8/1981	Luotonen et al.	52/730.7
4,615,163	10/1986	Curtis et al.	52/730.7
4,879,160	11/1989	Knudson et al.	52/309.2 X
4,965,973	10/1990	Engebretsen	52/223.8
5,050,366	9/1991	Gardner et al.	52/730.7

FOREIGN PATENT DOCUMENTS

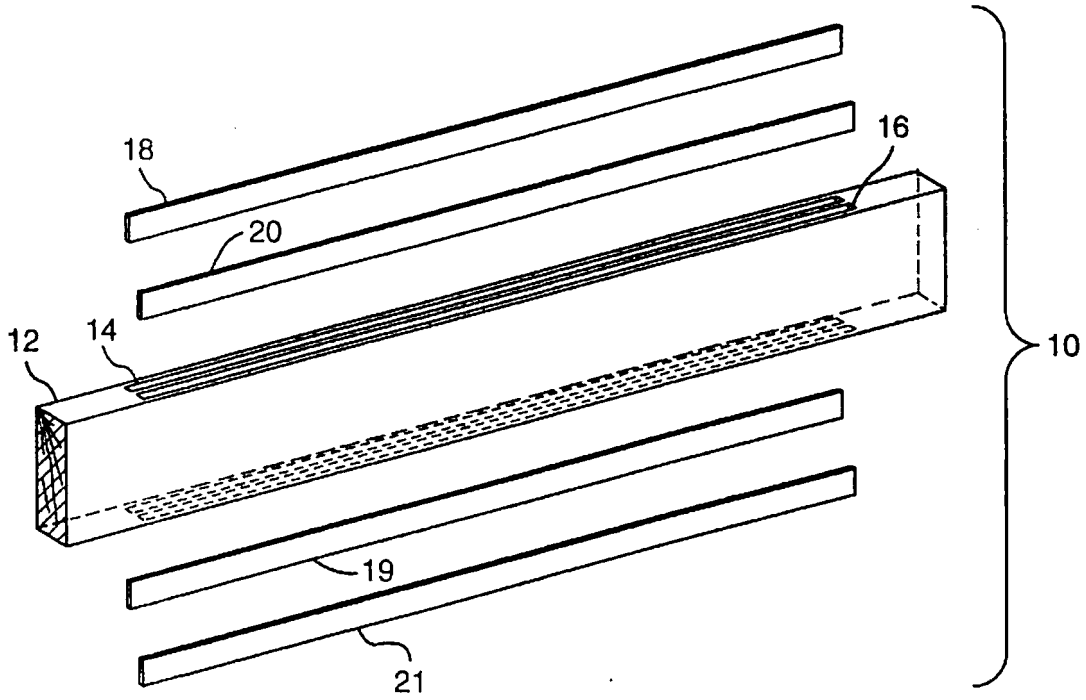
2531656	2/1977	Germany	52/730.7
203684	4/1966	Sweden	52/730.7
1675514	9/1991	U.S.S.R.	52/730.7
2003957	3/1979	United Kingdom	52/730.7

Primary Examiner—Carl D. Friedman
Assistant Examiner—Christopher Todd Kent
Attorney, Agent, or Firm—Jeffrey T. Imai; D. Doak Horne; Arne I. Fors

[57] ABSTRACT

A reinforced wood beam has a length and a longitudinally extending upper and lower surface. The upper and lower surfaces have a plurality of reinforcements. Each reinforcement comprises a steel strip bonded within a longitudinally extending kerf. The upper and lower surfaces each has at least two kerfs extending therealong and terminate intermediate of ends of the wood beam.

7 Claims, 2 Drawing Sheets



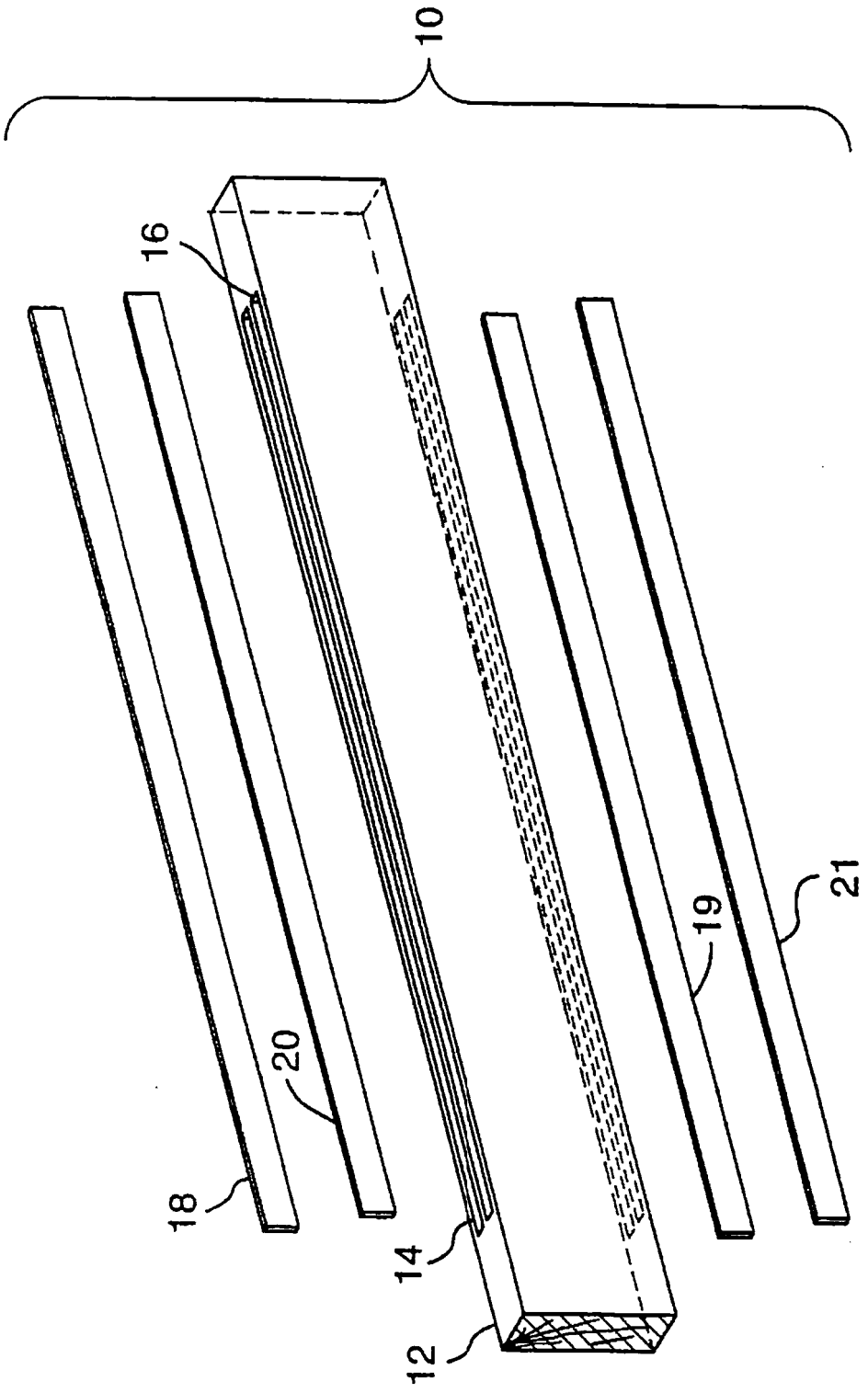


FIG.1.

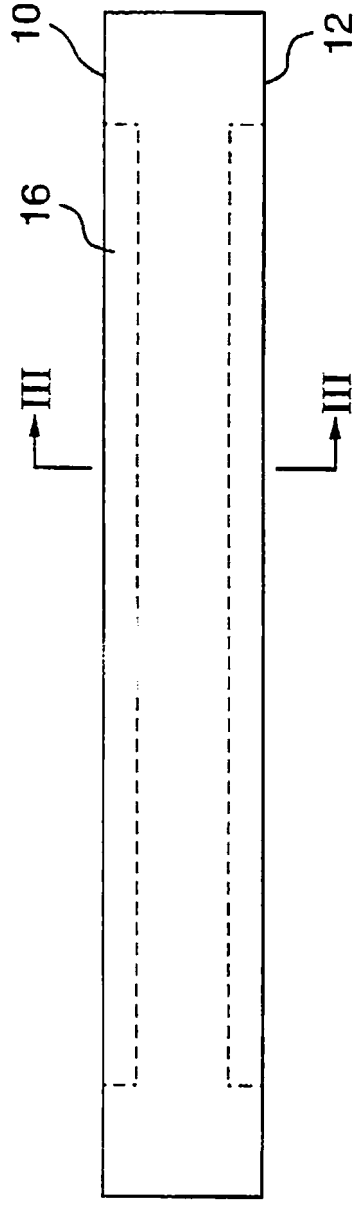


FIG.2.

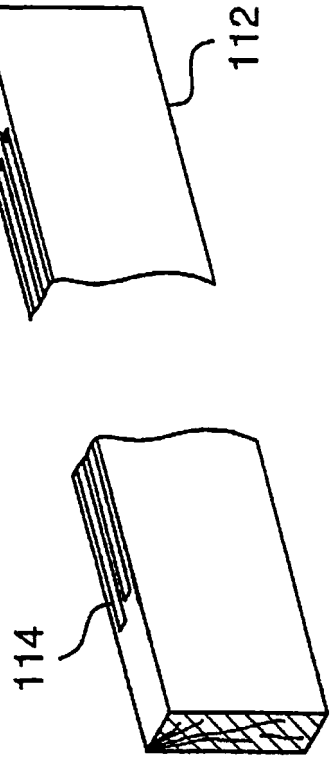


FIG.4.

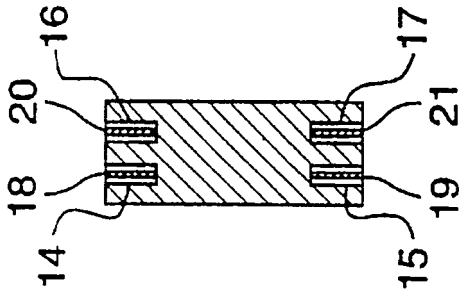


FIG.3.

METHOD OF REINFORCING WOOD BEAMS AND WOOD BEAMS MADE THEREFROM

FIELD OF THE INVENTION

This invention relates to a method of reinforcing wood beams and the wood beams made therefrom.

BACKGROUND OF THE INVENTION

Wood beams are a common structural component, particularly in residential buildings. Wood beams are commonly used as joists which span between two support points for supporting floors and ceilings.

Wood beams come in a variety of standard sizes, including 2×6, 2 ×8, 4×8, 4×10 and 6×12. Each size of beam has known and accepted characteristics of strength and deflection.

In designing a building, once the static and dynamic loads have been calculated the designer can select the size of the wood beam which will be used as the floor or ceiling joists. On selection of the size of beam, building codes and construction practices dictate the number and spacing of the joists.

In selecting the size of beam to be used a joist, the cost is a significant factor. Smaller size beams are generally less expensive than larger size beams. However, with smaller size beams, more beams are required to achieve the same load capacity. There is normally a trade off between the size of beams and the number of beams.

It would thus be advantageous if a smaller sized beam could be reinforced to increase the strength characteristics thereof in order to increase load capacity when used as a joist without dramatically increasing the cost.

SUMMARY OF THE INVENTION

The disadvantages of the prior art may be overcome by providing a wood beam with a plurality of longitudinally extending reinforcements in the upper and lower surfaces thereof. Each reinforcement comprises a length of steel glued or bonded into a kerf or groove in each of the upper and lower surfaces thereof.

According to one aspect of the invention, there is provided a reinforced wood beam having a length and a longitudinally extending upper and lower surface. The upper and lower surfaces have a plurality of reinforcements. Each reinforcement comprises a steel strip bonded within a longitudinally extending kerf. The upper and lower surfaces each has at least two kerfs extending therealong.

According to another aspect of the invention, the kerfs terminate intermediate of ends of the wood beam.

According to another aspect of the invention, the kerfs are staggered along the length of the wood beam.

According to another aspect of the invention, there is provided a method of manufacturing a reinforced wood beam. The method comprises the steps of:

cutting a plurality of longitudinally extending kerfs in an upper and lower surface of a wood beam,

inserting a bead of adhesive along the length of each of the kerfs,

inserting a steel strip in each of the kerfs, and

allowing the bead of adhesive to harden.

DESCRIPTION OF THE DRAWINGS

In figures which illustrate the embodiments of the invention,

FIG. 1 is a perspective view of the reinforced wood beam of the present invention;

FIG. 2 is a side elevational view of the reinforced wood beam of FIG. 1;

FIG. 3 is a cross-sectional view of the reinforced wood beam of FIG. 1 along the lines III—III of FIG. 2; and

FIG. 4 is a partial perspective view of a second embodiment of the present invention.

DETAILED DESCRIPTION OF INVENTION

FIG. 1 generally illustrates the reinforced wood beam of the present invention. Reinforced beam **10** comprises a wood beam **12** having a plurality of kerfs or grooves cut into the upper (**14, 16**) and lower surfaces (**15, 17**) thereof. Embedded within grooves **14, 15, 16** and **17**, are steel reinforcements **18, 19, 20** and **21**, respectively.

To manufacture the wood beam of the present invention, the kerfs **14, 15, 16** and **17** are cut in the upper and lower surfaces of the beam. A conventional table saw or router with guides may be used for this purpose. A bead of epoxy resin is ejected into the upper kerfs **14** and **16**. Reinforcements **18** and **20** are then hammered into the kerfs **14** and **16** securing reinforcements **18** and **20** within the epoxy resin which is then allowed to harden. The beam is flipped over and the process repeated for kerfs **15** and **17** and the insertion of reinforcements **19** and **21**.

The kerfs **14, 15, 16** and **17** extend longitudinally of the beam but preferably do not extend the entire length. The steel reinforcements equally do not extend the entire length. By terminating the reinforcements intermediate of the length of the beam, the ends of the beams may be cut off without damaging the reinforcement after the epoxy resin has hardened. If the reinforced beam is cut, not only is a special saw blade required but also the integrity of the bond between steel reinforcement and the wood beam may be compromised. A carpenter would be required to change saw blades to a metal cutting saw blade which increases the time for installation.

In use, the ends may be cut to fit the span between supports or to make fire cut ends.

Any type of two part epoxy resin may be used. Applicant has found that the two component epoxy available under the trade-mark PERMAQUICK 2030 provides satisfactory results.

Applicant has also found that sheet steel meeting ASTMA 446 Grade A cold rolled, mild grade steel will produce satisfactory results.

In the preferred embodiment illustrated in FIG. **1**, the beam has two longitudinally extending reinforcements **18** and **20** on the upper surface and two longitudinally extending reinforcements **19** and **21** on the lower surface. A satisfactory beam could be manufactured using only a single reinforcement in each of the upper and lower surfaces. However, the reinforcements would be required to be sized larger than the reinforcements used in the following example to achieve the same strength characteristics.

Two smaller reinforcements has the additional advantage that the kerfs are spaced towards the longitudinal edges of the upper and lower surfaces, leaving a strip of wood extending between the reinforcements. Normally, a carpen-

ter will aim for the center of the joist when nailing. The two smaller reinforcements reduces the likelihood of nailing into the epoxy or the steel reinforcement.

EXAMPLE 1

The reinforced joist was made of No. 1 and 2 grade SPF dimension lumber and sheet steel strips glued into top and bottom edges. A 2×8 (38×184 mm) joist and 1" 14 gauge (25×1.9 mm) strips of ASTMA 446 Grade A Steel was manufactured. Two parallel saw kerfs were cut in each of the top and bottom surfaces using a 2 mm blade. The kerfs were cut to a depth of 30 mm and spaced at 12 mm. A bead of two part epoxy resin was applied to each saw kerf and then the steel strips were pressed into place. The joist length was 4.27 meters with the steel strips having 2.74 meter length and centered in the length of the joist.

Recommended Maximum Spans

In the National Building Code of Canada 1990, the maximum spans for residential floor joists are based on several criteria. First, the bending moment capacity of the joist must not be exceeded. Second, the shear capacity of the joist must not be exceeded. Third, the live load deflection must not exceed $\frac{1}{360}$ of the span. Fourth, the vibration-controlled span must not be exceeded.

Bending Moment Resistance

For lumber products, design values are calculated on the basis of the lower fifth percentile of the population strength. For green reinforced lumber the value is 18.2 MPa. A basic dry characteristic value may be derived from this by applying a factor of 0.80 for load adjustment. The result is a characteristic bending strength of 17.2 MPa. This may be compared with the value of 11.8 MPa for unreinforced SPF joists in CAN3-086.1-M-89. The reinforcement produces an improvement of 46% in bending strength.

The factored moment resistance for single joists in Limit States Design is calculated by:

$$\begin{aligned} M_r &= \phi F b s \\ &= 0.9 \times 17.3\ \text{MPa} \times 0.214 \times 10^6\ \text{mm}^3 \\ &= 3.33\ \text{kN} \cdot \text{m} \end{aligned}$$

In typical floor construction this may be increased by a load sharing system adjustment. The adjustment for unreinforced sawn lumber is 1.40. For the reinforced joist, the factor is assumed to be 1.20 recognizing that the variability of this product is reduced. Thus the floor system moment resistance would be 4.0 kN.M.

Shear Resistance

The reinforcement in these joists is intended to improve the extreme fiber strength and stiffness. As such it does not improve or otherwise affect the longitudinal shear strength of the wood. Therefore, the published factored shear resistance is:

$$V_r = 5.03\ \text{kN}$$

As noted for moment resistance, the shear capacity may be adjusted in load sharing systems. For uniformity we recommend that this factor be 1.20. Thus the floor system shear resistance would be 6.0 kN.

Live Load Deflection

The test results for the green material show a mean stiffness value of $382 \times 10^9\ \text{N.mm}^2$.

Deflection-limited floor spans may be calculated from the dry EI. For a live load of 1.9 kPa, a spacing of 400 mm and a limiting deflection of $\frac{1}{360}$, the maximum span is 4.65m.

Vibration Controlled Span

This span is calculated according to National Building Code of Canada 1990 using a mid-span load of 1.0 kN with a maximum of 2 mm deflection. This span varies depending upon the floor type and whether strapping and bridging are present. For the case of 400 mm spacing, 15.5 mm nailed subfloor and strapping only, the maximum span is 3.90 m. This span is shorter than the live load deflection span and so vibration will be the limiting design criterion.

Summary

Load testing was done to determine design properties for steel-reinforced 38×184 wood joists. Recommended properties for Limit States Design in load sharing systems are as follows:

Factored Moment Resistance	4.0 kN · m
Factored Shear Resistance	6.0 kN
Stiffness	$359 \times 10^9\ \text{N} \cdot \text{mm}^2$

Maximum spans for residential floors have been calculated using the above properties and the procedures recommended by National Building Code of Canada 1990. The results are found in Table 1.

It has been found that the load share between the wood and reinforcement is about 42% carried by the wood and about 58% carried by the reinforcement. The tested samples of 2×8 beams according to the present invention were found to have an actual stiffness improvement over an unreinforced beam by about 1.92.

In use, a 2×8 reinforced beam according to the present invention has an equivalent strength and load characteristics of a unreinforced 2×10 wood beam. In a building, there may be a requirement for a joist over a 14 foot span, which requires a 2×10 beam. Since a 2×10 joist is required, all other joists and headers must 2×10, even though the other shorter spans could use a 2×8 joist. By using a 2×8 joist according to the present invention over the 14 spans, the remainder of the floor joists could use unreinforced 2×8 joists. This results in cost savings not only being able to use lesser priced unreinforced 2×8 joists but also for savings in cladding materials due to the 2 inch difference.

Referring to FIG. 4, a second embodiment of the present invention is illustrated. In this embodiment, the kerfs 114 and 116 are staggered along the length of the wood beam 112.

It is now apparent to a person skilled in the art that the reinforced wood beam of the present invention could be readily modified. It is understood that certain changes in style, size and components may be effective without departure from the spirit of the invention and within the scope of the appended claims.

TABLE 1

	Maximum Span in Meters Living Area Floors		
Spacing (mm)	Strapping only	Bridging only	Strapping & Bridging
300	4.10	4.39	4.61
400	3.90	4.13	4,29
600	3.70	3.90	3.91

I claim:

1. A reinforced wood beam having a longitudinally extending upper and a lower surface, said upper and lower surfaces having a plurality of reinforcements bonded therein, said reinforcements each comprising a steel strip

bonded within a longitudinally extending kerf, said reinforcements spaced from a midpoint of a width of said wood beam.

2. A reinforced beam as claimed in claim 1 wherein said upper and lower surfaces each has at least two of said kerfs extending therealong.

3. A reinforced beam as claimed in claim 2 wherein said kerfs terminate intermediate of ends of said wood beam.

4. A reinforced beam as claimed in claim 3 wherein said kerfs are staggered along the length of said wood beam.

5. A reinforced beam as claimed in claim 1 wherein said steel strip is bonded with a two component epoxy resin.

6. A reinforced beam as claimed in claim 1 wherein each of said kerfs has a kerf width, and each of said kerf widths to the width of said surfaces is in a ratio of about 1 to 20.

7. A reinforced beam as claimed in claim 6 wherein said upper and lower surfaces each has two reinforcements.

* * * * *

Appendix 2G – U.S. Patent 5,694,730 "Del Rincon"

US005694730A

United States Patent [19]

Del Rincon et al.

[11] Patent Number: 5,694,730

[45] Date of Patent: Dec. 9, 1997

[54] SPLINE FOR JOINING BOARDS

[75] Inventors: Eduardo Del Rincon, Pierrefonds; Alexandre Polisois, Boisbrand, both of Canada

[73] Assignee: Noranda Inc., Toronto, Canada

[21] Appl. No.: 736,961

[22] Filed: Oct. 25, 1996

[51] Int. Cl.[6] E04B 1/38; F16B 13/00

[52] U.S. Cl. 52/586.1; 52/698; 52/586.2; 52/302.1; 52/396.05; 403/298

[58] Field of Search 52/586.1, 586.2, 52/582.1, 704, 712, 396.05, 396.1, 302.1, 302.3, 394, 468, 698; 403/298, 294, 292, 405.1; 411/458, 460, 921, 439

[56] References Cited

U.S. PATENT DOCUMENTS

1,018,987	2/1912	Philpot .	
1,723,306	8/1929	Sipe .	
3,507,083	4/1970	Fish, Jr. et al. .	
3,563,582	2/1971	Shroyer et al. .	
3,662,805	5/1972	Sygnator .	
3,874,142	4/1975	Dallen .	
3,875,719	4/1975	Menge .	
4,157,271	6/1979	Moore .	
4,599,841	7/1986	Haid	52/586.2 X
4,833,858	5/1989	Hutchison .	
5,182,892	2/1993	Chase .	
5,263,294	11/1993	Koenig et al.	52/468
5,297,892	3/1994	Preziosa .	
5,433,806	7/1995	Pasquali et al. .	
5,438,809	8/1995	Ehrlich .	

FOREIGN PATENT DOCUMENTS

9533898 12/1995 WIPO .

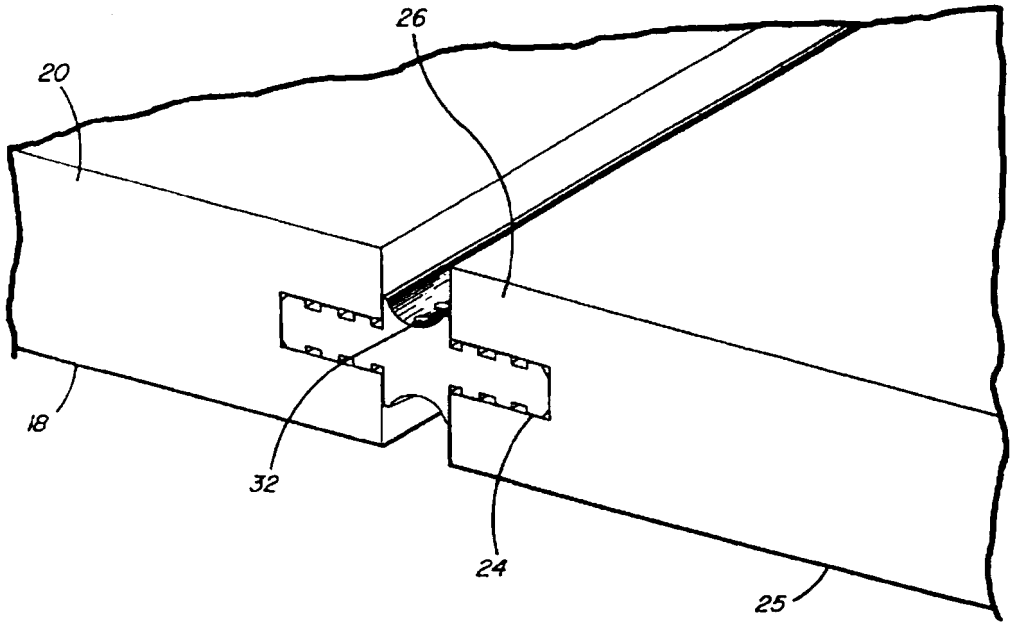
Primary Examiner—Robert Canfield

Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper & Scinto

[57] ABSTRACT

A spline for joining wood boards or panels with a groove extending throughout their longitudinal sections. The spline has a body with an upper surface and a lower surface, and central concave ridges on the at least one of upper and lower surfaces for draining water. The ridge extends throughout the length of the spline so that when two adjacent boards or panels are joined by the spline, the space between the boards or panels or equal to the width of the ridge. The spline has been designed to provided efficient drainage of water, thus preventing and substantially limiting swelling, if any, of the boards. The spline of the present invention provides a joint with mechanical and resistance properties comparable to conventional tongue and groove boards.

10 Claims, 3 Drawing Sheets



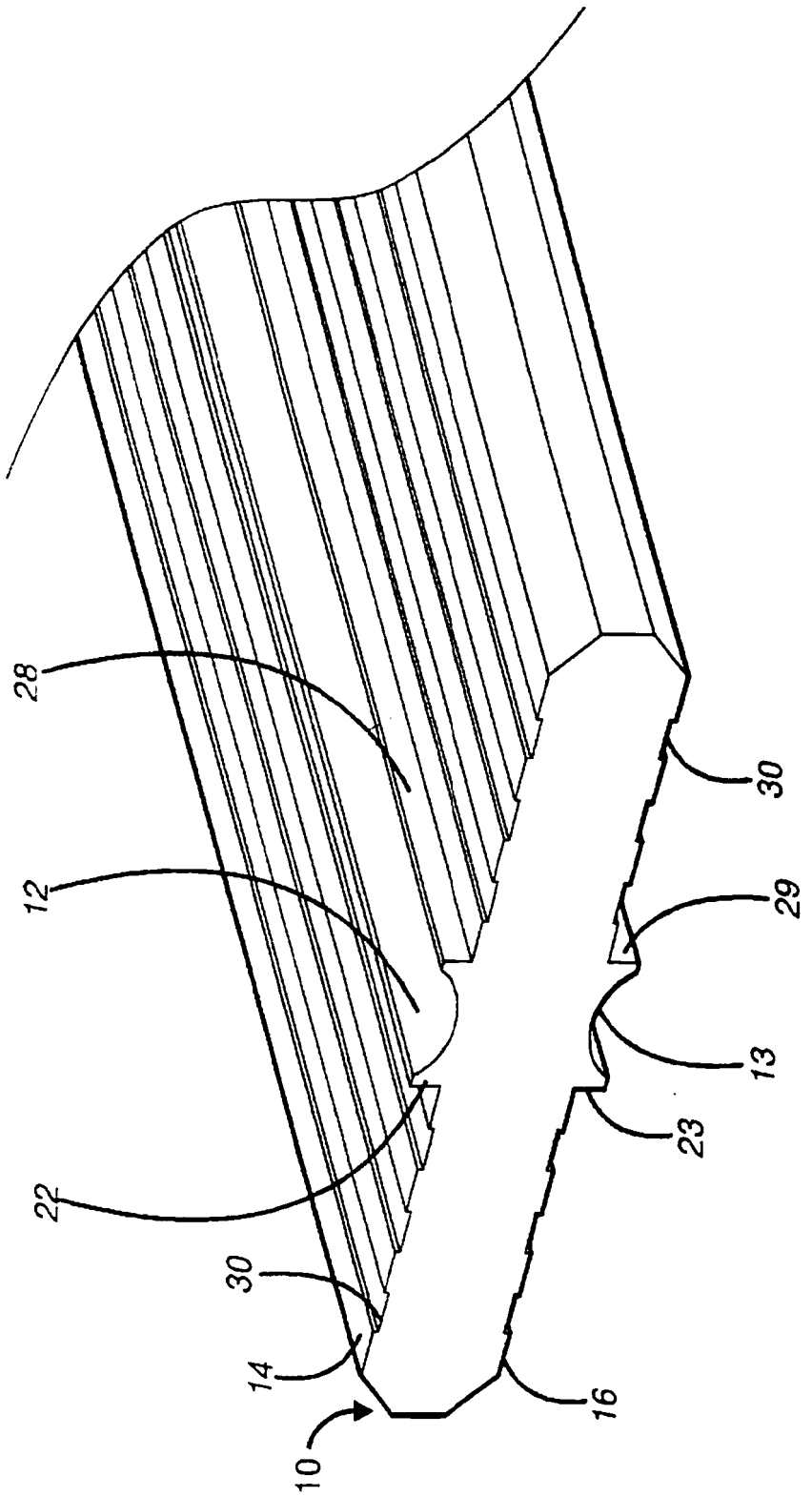


Fig. 1

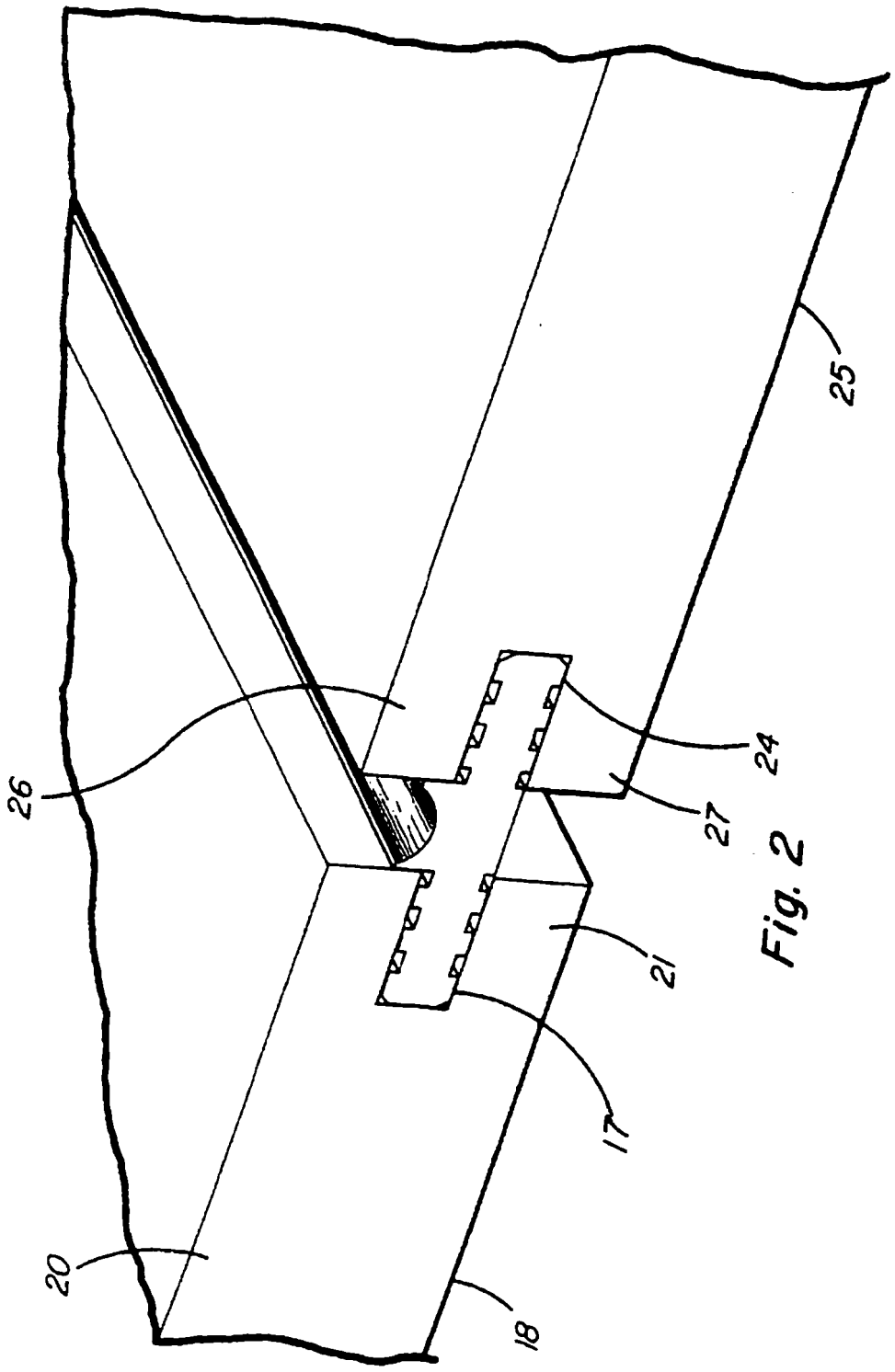


Fig. 2

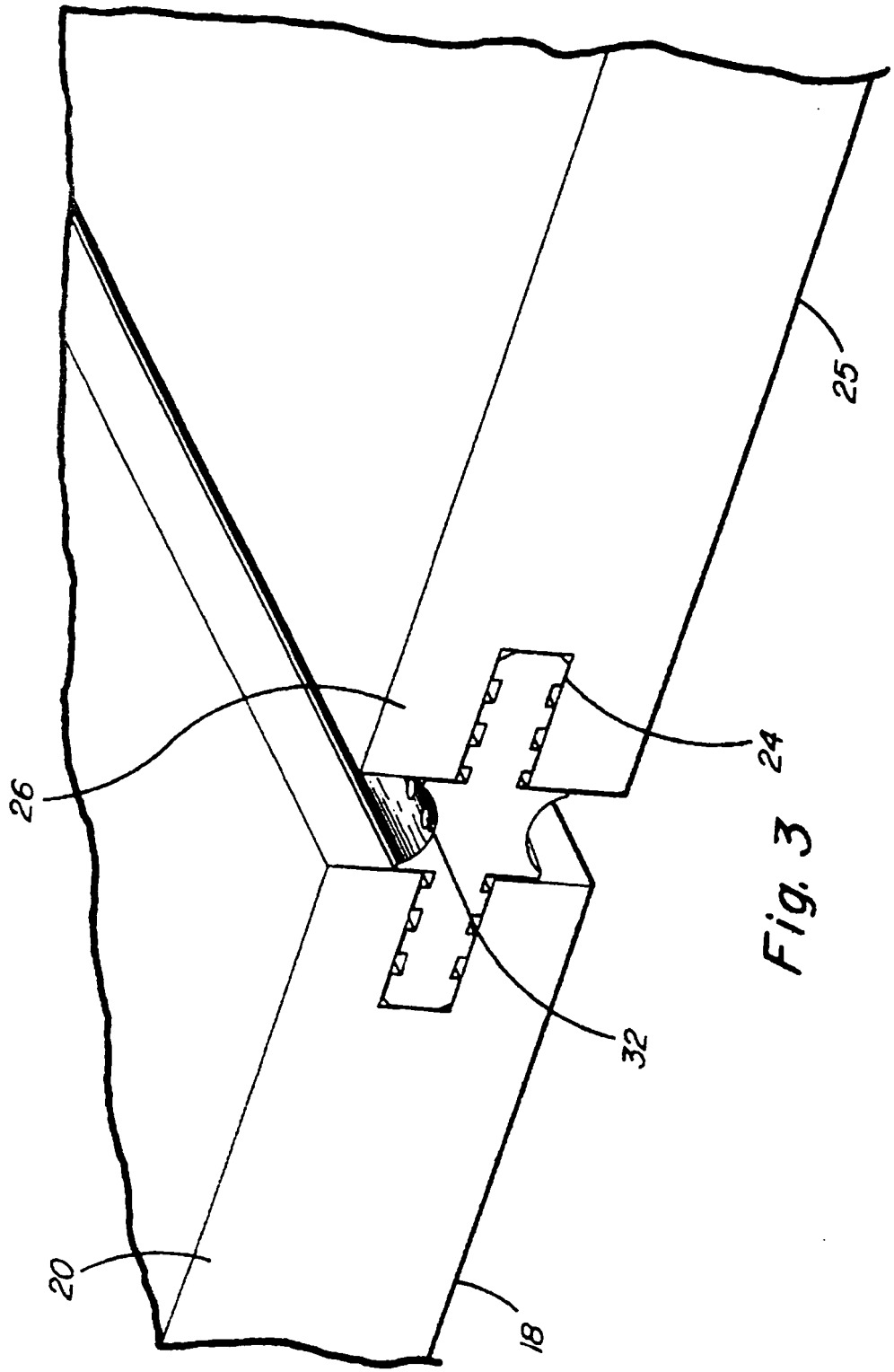


Fig. 3

SPLINE FOR JOINING BOARDS

FIELD OF THE INVENTION

The present invention is concerned with a novel spline for joining boards. The spline is designed in such a manner that water is drained efficiently to prevent swelling of the boards. allows for gaps between two adjacent boards in compliance with building codes, and provides a joint with mechanical and resistance properties comparable to conventional tongue and groove boards.

BACKGROUND OF THE INVENTION

The use of tongue and groove panels or boards for building structures like walls, roofs, floors etc. is conventional. These boards are generally made of wood and include plywood, oriented strand boards (OSB), presswood and the like. To ensure a good mechanical joint between the boards, several tongue and groove designs have been developed. A few problems are, however, associated with these boards and resulting board assemblies. For example, the tongue is sometimes broken when inserted in the groove of an adjacent board, thus causing weaker sections in the assembly formed thereof.

Another major concern is swelling. Although the longitudinal sections of the boards are generally sprayed with a conventional sealer, the presence of water, if not removed, will cause irreversible swelling, thus causing deformation and/or irregularities on the surface and weakening the structure of the board assembly. As a result, the mechanical properties are greatly affected. To avoid such problems, a tongue and groove panel structure has been proposed in U.S. Pat. No. 5,182,892 wherein the tongue is slightly longer that the groove, thus creating a small space between two adjacent panels. Further, the tongue is provided with slots at regular intervals to drain any water present on the surface.

The use of splines, also called joints or strips, for joined two boards or panels is a well-known alternative to tongue and groove boards. Typically, all the longitudinal sections of the boards are grooved, and two adjacent boards are joint by inserting one half of a spline in the groove of one panel, and the other half in the groove of the adjacent panel. Generally, no further fastening is required between the panels. Again, for wood panels, the problem of swelling still remains. Further, if a load is applied on only one side of the spline, i.e., on one panel, it will cause the spline to sag and significantly reduce load transfer capacity.

There is therefore a great need to develop a spline having a structure allowing the drainage of water without causing any assembly deformations or weakening. The mechanical properties of a surface made of boards assembled with such splines should be comparable to those of a surface made of conventional tongue and groove boards, otherwise they would be hardly accepted by the industry.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is now provided a spline or strip for joining boards. More specifically, the spline comprises a central concave ridge, preferably U-shaped, extending throughout the length of the spline. The longitudinal section of each panel will abut on each side of the ridge, leaving a space between the boards equal to the width of the ridge, for draining the water. A plurality of recesses or grooves are preferably provided on each side of the ridge on the upper and lower surfaces of the spline, and extend parallel to the ridge throughout the length of the spline. Such recesses are provided to improve the retention of the boards by the spline.

In a preferred embodiment, the spline is provided with a central ridge on its upper and lower surfaces.

Preferably, the spline is made of a thermoplastic material like polyethylene, polypropylene, polyvinyl chloride, nylon, polystyrene, polyurethane and the like. Also included are thermosetting materials like polyesters, vinyl esters, epoxy and the like. Composite materials like wood chips embedded in thermoplastic materials such as those listed above may also be used.

IN THE DRAWINGS

FIG. 1 illustrates a perspective view of the spline of the present invention;

FIG. 2 illustrates the present spline when inserted between two boards and comprising a ridge on only one surface of thereof; and

FIG. 3 illustrates a spline as shown in FIG. 1 and comprising a plurality of openings for draining the water.

DETAILED DESCRIPTION OF THE INVENTION

The present spline has been designed to facilitate the drainage of water from surfaces made of boards joined therewith while insuring that mechanical properties remain comparable to those of conventional tongue and groove boards. The development of the present spline also required that it respected the distance between adjacent boards as provided in the building code. Referring to the drawings, there is provided a spline **10** made of a material such as polyethylene, polypropylene, polyvinyl chloride, nylon, polystyrene, polyurethane and the like, comprising U-shaped central ridges **12** and **13** on upper and lower surfaces **14** and **16** respectively, and extending throughout the length of spline **10**. Only one of ridges **12** and **13** could be present, as illustrated in FIG. 2 to insure proper spacing between the boards. However, a ridge on each surface is most preferred, especially because if a load is applied on only one side of the spline, i.e., on only one board, it is not possible for the spline to sag because movement of the spline is prevented by the ridges. The direct result is therefore a better load transfer capacity.

Spline **10** is inserted in groove **17** of a first board **18** until the longitudinal protruding sections **20** and **21** of the board abut the sides **22** and **23** of ridges **12** and **13**. The other side of spline **10** is then inserted into the longitudinal groove **24** of a second board **25** until its protruding longitudinal section **26** and **27** abut the sides **28** and **29** of ridges **12** and **13**. Spline **10** is also provided with a plurality of recesses or grooves **30** to maximize the board retention by the spline.

In the event that the board assembly is substantially flat, holes **32** may be made in spline **10** through ridges **12** and **13**, as illustrated in FIG. 3. On the other hand, if there is a slope in the board assembly, for example, in roofing, then such holes are optional since the slope will be sufficient to drain the water away. Preferably, there should be a space or gap between the inner surface of the groove and the spline's end inserted therein to allow linear expansion of the wood.

The stiffness ratio and the average load transfer ratio have been used to compare the properties of conventional 4×8 tongue and groove boards, and 4×8 boards joined with a spline according to the present invention. The stiffness ratio is defined as the ratio of the slopes of the straight portion of the load deflection curves for the continuous portion of the

assembled board to the assembled edge, respectively. The average load transfer ratio is calculated by the following equation:

$$\text{load transfer ratio} = 1 - (\Delta_{assembled} - \Delta_{centre}) / (\Delta_{free} - \Delta_{centre})$$

wherein

$\Delta_{assembled}$=deflection of panel under the load point 38 mm from the edge of an assembled tongue and groove;

Δ_{centre}=deflection of panel under the load point in the centre of the half panel; and

Δ_{free}=deflection of panel under the load point 38 mm from the edge of the free tongue or groove

Experimental results show that the average stiffness ratio for an assembly of boards assembled with the present spline, is 0.768, and that the average load transfer ratio of such assembly is 0.621. In comparison, the average stiffness ratio for conventional tongue and groove boards is 0.805, and the average load transfer ratio is 0.724. The results therefore show that these properties are very similar for either assembly.

The cavity of the ridge is preferably U-shaped, but it could be shaped otherwise, as long as there is a concave shape.

With respect to the size of the spline, preferred dimensions are as follows.

These dimensions are for 4×8 boards having a thickness of ⅜".

width of the spline: 13 mm

width of the ridge: 3 mm

height of the ridge: 0.7 mm

thickness of the spline: 5 mm

The above dimensions have been optimized to reduce as much as possible the amount of material required to make the spline. These dimensions could be further modified. For example, the width of the spline could be greater, but since it would require more material, the cost of the spline would increase. The same applies for the width and height of the ridge, i.e., the ridge could be high enough so that its upper portion is flush with the surface of the board. Finally, the thickness of the spline is limited by the thickness of the board. Thinner boards will require thinner splines, and thicker boards will require thicker splines. For example, spline joining ½" thick boards could have a thickness of about 4 mm, while for ¾" thick boards, it could be 6 mm.

Since the present spline is made of thermoplastic material or thermosetting material, it can be prepared by any conventional process such as molding or extruding processes, and the like. The spline is typically produced in sections of 4 or 8 feet, but these sections could be longer or shorter, depending on the needs of the end user. Further, the spline does not need to be inserted throughout the whole section of the board as a single piece. For example, an 8 feet section of a board could be filled with 2 splines of 3.5 feet each, or 3 splines of 2.5 feet each, the spaces between the splines further improving water drainage.

While the invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modifications and this application is intended to cover any variations, uses or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice within the art to which the invention pertains, and as may be applied to the essential features hereinbefore set forth, and as follows in the scope of the appended claims.

What is claimed is:

1. A spline for joining two boards or panels provided with a groove extending throughout their longitudinal sections, the spline comprising a body with an upper surface and a lower surface, and a central concave ridge on the upper and lower surfaces for draining water, the ridge extending throughout the length of the spline, so that when two adjacent boards or panels are joined by the spline, the space between the boards or panels is equal to the width of the ridge.

2. A spline according to claim 1 wherein the spline is made of a thermoplastic material or a thermosetting material.

3. A spline according to claim 2 wherein the thermoplastic material is selected from the group consisting of polyethylene, polypropylene, polyvinyl chloride, nylon, polystyrene, polyurethane or combinations thereof, and wherein the thermosetting material is selected from the group consisting of polyesters, vinyl esters, epoxy and combinations thereof.

4. A spline according to claim 1 wherein the ridge is U-shaped.

5. A spline according to claim 1 wherein the spline joins boards or panels are made of wood.

6. A spline for joining two boards or panels provided with a groove extending throughout their longitudinal sections, the spline comprising a body with an upper surface and a lower surface, and a central concave ridge on at least one of the upper or lower surface for draining water, the ridge extending throughout the length of the spline so that when two adjacent boards or panels are joined by the spline, the space between the boards or panels is equal to the width of the ridge, a series of holes being disposed in the ridge.

7. A spline for joining two boards or panels provided with a groove extending throughout their longitudinal sections, the spline comprising a body with an upper surface and a lower surface, and a central concave ridge on at least one of the upper or lower surface for draining water, the ridge extending throughout the length of the spline so that when two adjacent boards or panels are joined by the spline, the space between the boards or panels is equal to the width of the ridge, wherein the upper and lower surfaces each comprise a plurality of recesses extending throughout the length of the spline and parallel to the ridge.

8. A thermoplastic spline for joining two boards or panels of wood provided with a groove extending throughout their longitudinal sections, the spline comprising a body with an upper surface and a lower surface, and a central concave ridge extending throughout the length of the spline on the upper and lower surfaces, the upper and lower surfaces further comprising a plurality of recesses extending throughout the length of the spline and parallel to the ridge, so that when two adjacent boards or panels are joined by the spline, the space between the boards or panels is equal to the width of the ridge.

9. A spline according to claim 8 further comprising a series of holes in the ridges.

10. A spline according to claim 8 made of a material selected from the group consisting of polyethylene, polypropylene, polyvinyl chloride, nylon, polystyrene, polyurethane, polyesters, vinyl esters, epoxy or combinations thereof.

* * * * *

Appendix 3 - Related proceedings

None